Popular Science

FOUNDED MONTHLY 1872

INVENTIONS
DISCOVERIES
RADIO
AUTOMOBILES
AVIATION
HOME WORKSHOP

WE WILL PAY $10,000 IN CASH

What's Wrong in this Picture?

For This Great Contest See Page 19

JULY 25 CENTS

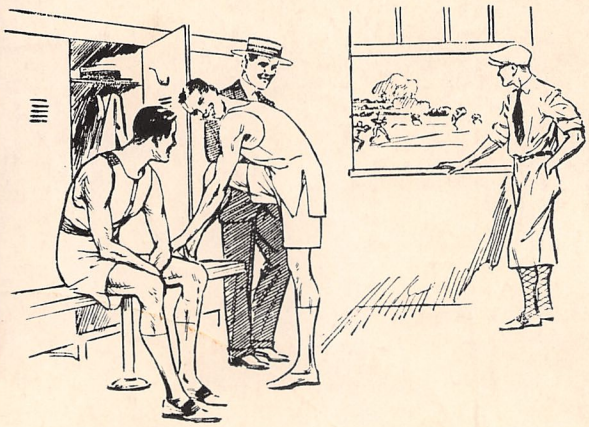
"Next to myself I like 'B.V. D.' best"

Not Exactly Dressed~ But *Well*~Dressed Just the Same!

Summer Sports and constant locker-room changes!

Men meeting frequently in underdress!

None so neat and cool as those in good old "B.V.D."!



DECADES of world leadership have enabled The B.V.D. Company, Inc., to put otherwise unattainable values into "B.V.D." Underwear.

The carefully shaped lines, finished tailoring, noticeable drape, and perfect proportions of "B. V. D." stand out, with its unvarying quality, as the product of extraordinary facilities and highly specialized methods used by us alone.

In "B.V. D." Union Suits, the celebrated "B.V. D." closed crotch is patented. So are the construction at the shoulder and the reinforcement at the back of the unique encircling waistband. In all "B.V. D." garments, distinctive design and tailoring achieve the highest ease and fine fit with neither too much nor too little fullness.

And "B. V. D." garments hold their shapeliness through such wash and wear as would play havoc with ordinary underwear. For they are tailored with lock-stitched "can't rip" seams, from cool, super-durable "B. V. D." nainsook, created by special processes in our own mills and bleachery, and used in "B. V. D." and no other underwear.

To avoid those underwear "regrets" which rise so sharply with the thermometer—

GET THE UNDERWEAR YOU ASK FOR!

INSIST UPON *THIS* RED WOVEN LABEL

MADE FOR THE B.V.D. BEST RETAIL TRADE

(Trade Mark Reg. U.S. Pat. Off. and Foreign Countries)

We Want You to be Properly Fitted!

FOR the maximum of union suit comfort, be correctly measured for "B. V. D."

Your proper union suit size can always be determined by three simple, encircling, tape-measurements: (1) chest, (2) waist, (3) trunk (under the crotch and over the shoulder).

If you or the retailer are in any doubt as to your size, write The B. V. D. Service Bureau, 350 Broadway, New York City, giving your waist, chest, and trunk measurements, and your problem will receive immediate attention.

"B. V. D."
Union Suit
(Patented Features)
Men's $1.50 the suit
Youths' 85c

"B. V. D."
Shirts and Drawers
85c the garment

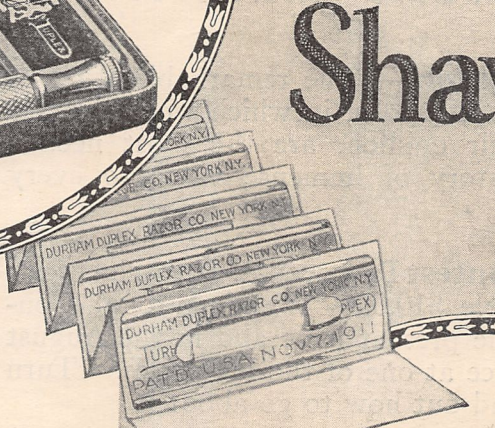
Men's "B. V. D." Underwear in fancy materials at various prices

The B. V. D. Company, Inc., New York

Sole Makers of "B. V. D." Underwear

© 1925 The B.V.D.Co.

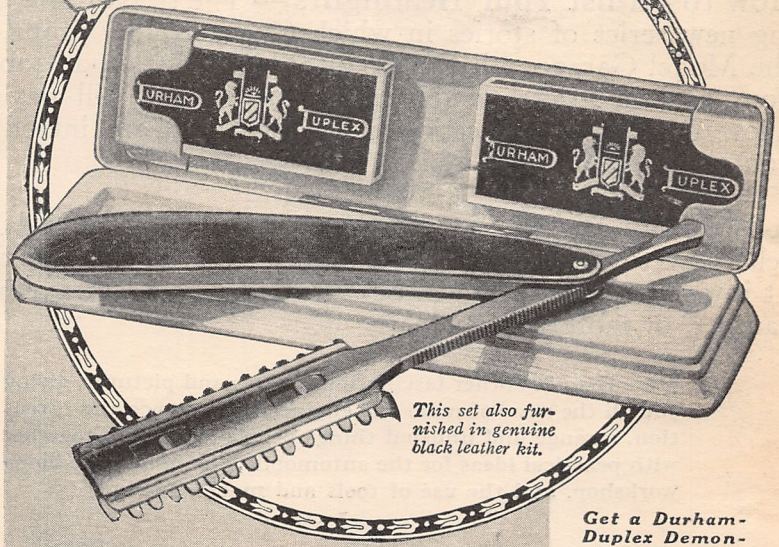
the Good Morning Shave



Handsome New Durham-Duplex Sets

THE most durable as well as the most beautiful razor sets ever offered to the Shaving Men of America. A *lifetime* of Good Morning shaves in every one.

Take your choice—whether you prefer the "Safety" type razor or the long-handled "Safe" style. Ten of the same famous long Durham-Duplex Blades with each set—months of the quickest, smoothest shaving you've ever enjoyed.



This set also furnished in genuine black leather kit.

Either Set $1.50 Complete

Including two 50c packages of 5 Durham-Duplex Blades—20 shaving edges.

Interchangeable Blades 50c for Package of 5

DURHAM-DUPLEX RAZOR CO., Jersey City, N. J.
Factories: Jersey City; Sheffield, Eng.; Paris, France; Toronto, Can. *Sales Representatives in All Countries.*

Get a Durham-Duplex Demonstrator Razor with one double-edged blade for 25 cents. (Either style.) A real Razor—not a toy. If your dealer cannot supply you mail the coupon at once.

DURHAM-DUPLEX

The Blades Men Swear By-Not At

25¢

DURHAM-DUPLEX RAZOR CO., Jersey City, N. J.
I am enclosing 25c. Please send me a Durham-Duplex Razor with one blade.
PS-7
Name
Address
Mark x for razor preferred. Safety Style ☐ Long handled "Safe" style ☐

Popular Science Monthly

The Magazine of Invention and Discovery

JULY, 1925; Vol. 107, No. 1
25 cents a Copy; $2.50 a Year

Published in New York City at
250 Fourth Avenue

Coming Next Month

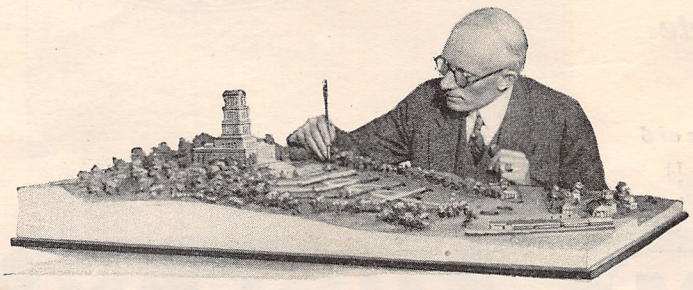
What's Wanted from Inventors — The remarkable story of one of the world's most unusual books, in which world-famous men jot down what, in their opinion, are the most needed inventions of the day. A story of immense value to every inventor.

The Third Set of $10,000 Contest Pictures — If you have not already entered our remarkable $10,000 "What's Wrong" Contest, you still can do so in the present issue and in the August issue. You still have a chance at one of the big prizes. Turn to page 19 of this issue to find out how to go about it.

How to Adjust Your Headlights — The second of a fascinating new series of stories in which Gus and Joe, proprietors of the Model Garage, tell you how to do the little odd jobs about your car that save trouble and expense. It will pay you to know these two interesting characters who are introduced to you on page 73 of this issue.

A Portable Radio Set for Every Purpose — Alfred P. Lane tells how to build a compact, highly efficient receiver that will fit in any suitcase and will be a delight to every traveling man, camper, or motorist.

More than 200 other fascinating articles and pictures, giving you all the news of radio and engineering, science and invention, strange and unusual things people are doing, together with practical ideas for the automobile, the home, the home workshop, and the use of tools and machinery.



Harvey Wiley Corbett, president of the Architectural League of New York, an international expert on city planning, whose amazing prophecy of the Gargantuan cities of the future will appear in our next month's issue

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POPULAR SCIENCE MONTHLY

Issued monthly. Single copy, 25 cents. Yearly subscription to United States, its possessions, and Canada, $2.50; foreign countries, $3. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Dunellen, N. J. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A.

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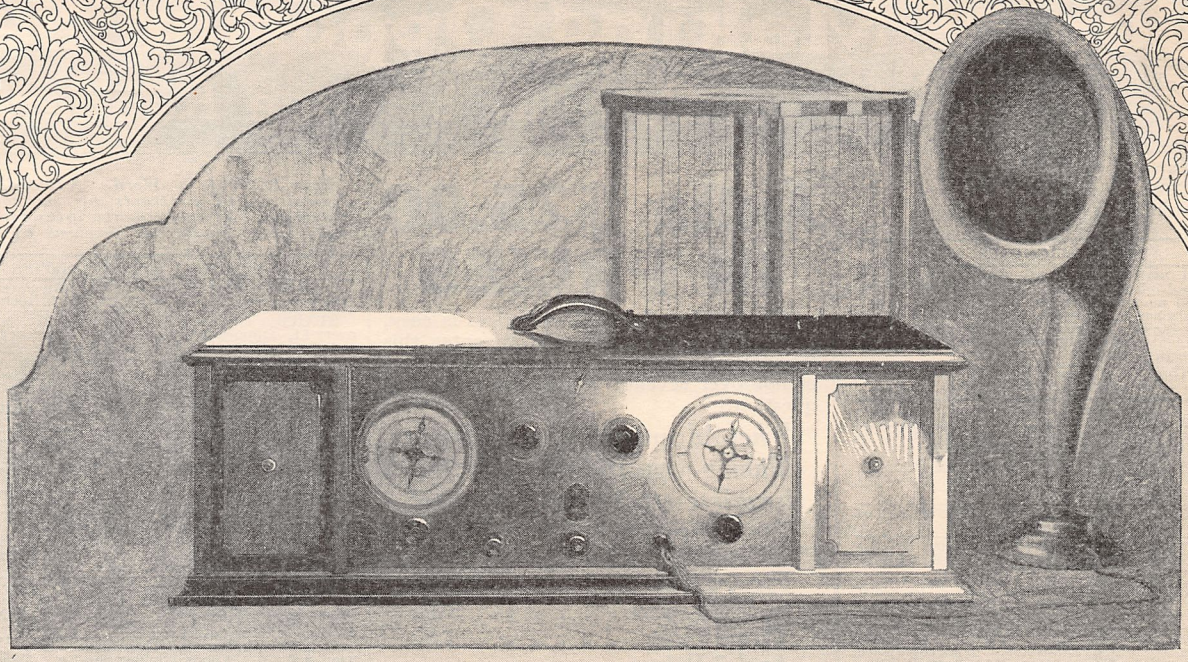
O. B. Capen, President and Treasurer; R. C. Wilson, Vice-President; A. L. Cole, Secretary.



Leadership in Radio

The nation looks to the Radio Corporation of America not only for the production of ever better Radiolas and the development of Radiotrons; not only for advances in international radio telegraphy and country-wide radio broadcasting; but for an honesty of statement that shall pierce the fog of radio claims and counter-claims with conservative promise and confidence-building performance.

Radiola Super-Heterodyne—the far-famed set that needs no antenna—no connections of any sort. Its fame is not only for its big performance but for its simplicity and its *tone quality*.

Radio Corporation of America

Sales Offices:

233 Broadway, New York
10 So. La Salle Street, Chicago, Ill.
28 Geary Street, San Francisco, Cal.

Radiola

REG. U.S. PAT. OFF.

PRODUCED ONLY BY RCA

RCA

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 17.

Money Making Opportunities for "Popular Science" Readers

ADDING MACHINES

FREE trial, marvelous free adding machine. Adds, subtracts, multiplies, divides, automatically. Work equals $350.00 machine. Price only $15.00. Speedy, durable, handsome. Five-year guarantee. Used by largest corporations. Write today for catalog and free trial offer. Lightning Calculator Co., Dept. O, Grand Rapids, Michigan.

ADDING Machines, listers, 8 bank, $35.00 C. O. D. Cantwell. Peru, Illinois.

ADVERTISING SERVICES

ADVERTISE in 24 metropolitan dailies, 24 words, $15.00. Helpful Guide listing 1000 publications, 4c stamps. Wade Company, Baltimore Bldg., Chicago.

24 WORD ad 355 rural weeklies, $14.20. Ad-Meyer, 4112P Hartford, St. Louis.

CIRCULARIZE guaranteed lists. Agents' names, $5.00, 1,000. Pennell, Covington, Ky.

AGENTS' names neatly typewritten from our one day old inquiry letters. Price right. A. World, 166-W. Washington, Chicago.

COMBINATION Winner. 125 Magazines, 10c word, $8.00 inch. Thrice, Interstate Advertiser, Munsing, Mich.

I WRITE booklets, folders, letters, complete follow-up for manufacturers, Mail order dealers. Long experience. Write for prices. L. Taylor, Box S44, Freeport, Ill.

25 words 88 magazines, $1.00, thrice $2.00, Smith's Service, Wenatchee, Wash.

AMERICAN MADE TOYS AND NOVELTIES

OPPORTUNITY to start Manufacturing Metal Toys and Novelties. No experience necessary. Enormous demand exceeds supply. We furnish, at cost, casting forms for production and buy entire output, also place yearly contract orders. Casting forms made to order. Catalog, advice and information free. Metal Cast Products Co., 1696 Boston Road, New York.

AUTHORS AND MANUSCRIPTS

PHOTOPLAY—Story Ideas wanted. $25-$500 paid. Experience unnecessary; outline Free to anyone. Write Producers League, 312 St. Louis.

WRITERS—Stories, poems, plays, etc., are wanted for publication. Literary Bureau, 117, Hannibal, Missouri.

$$$ FOR ideas. Photoplay plots accepted any form, revised, criticized, copyrighted, marketed. Advice free. Universal Scenario Corporation, 214 Security Bldg., Santa Monica and Western Avenue, Hollywood, California.

I WANT song poems. Casper Nathan, J-3544 No. Racine, Chicago.

SONG Poem Writers send for proposition. Ray Hibbeler, D10, 4040 Dickens Av., Chicago.

AUTOMOBILES AND ACCESSORIES

STOP—Daily Grind. Money! Re-silvering Auto-parts, mirrors, tableware, stoves. Outfits. Plans Free. Sprinkle, Plater, 96 Marion, Indiana.

LIGHTNING Puncture Seal, eliminates puncture complications indefinitely. Equitable formula $3.00. J. Skeen, Lake Creek, Texas.

AUTOISTS. Know whether your Headlights are lighted. Our "IS-IT-LIT" Telltales for $1.25 are positive indicators. If out of gas on the road our Gas Siphon Pump will enable you to borrow from the first passing car and get home; price $2.50. Handy Specialty Co., Somerville, Mass.

HOW to rewind Ford armatures, $1.00. Kelsie Click, Mt. Vernon, Ohio.

AUTOMOBILE Parts—Used parts for most any car at half factory list prices. Allen, Brisco, Buick, Cadillac, Chalmers, Chevrolet, Dodge, Dort, Grant, Hudson, Hupmobile, Oakland, Overland, Oldsmobile, Reo, Studebaker, and many others. Send list of parts wanted. Century Auto Parts Co., 4105 Olive Street, St. Louis, Missouri.

THE SUPERBA polishes shoes, brass, etc., grinds valves, removes carbon, drills, polishes, saves time, money, effort, complaint. Send for circular. Sirianni & Trumbettas Mfg. Co., 6 Brown St., Carbondale, Pa.

AVIATION

The American School of Aviation announces a new correspondence course in mechanics of aviation. A thorough training in practical aeronautics. American School of Aviation. Dept. 6741, 3601 Michigan, Ave., Chicago, Illinois.

BOYS fly this three-foot model aeroplane. Small cost. Write for circulars. Aero Shop, 3050 Hurlbut Ave., Detroit, Mich.

GREATEST Glider Airplane. Flies 300 feet. Prepaid 35c. Big model catalog 5c. W. H. Phipps, 578 Knickerbocker Ave., Brooklyn, N. Y.

AIRPLANE turnbuckles, new, very useful for truing-up sagging doors or gates and radio wires send 25c for two samples postpaid. Write for our sales bulletin it's free. Johnson Airplane Supply Co., Dayton, Ohio.

BOATS AND LAUNCHES

BOATS that always go are propelled by Ford engines. Ford dope free to boat owners. Harry Rider, East Norwalk, Conn.

BOOKS AND PERIODICALS

LAFFALOG is a monthly magazine devoted to Wit and Wisdom, Poems and Formulas. Sample copy 10c. W. H. Gilbert, Box 26K, Milford, Conn.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Ave., New York.

Another $25.00 IN PRIZES

To win one of these cash prizes is easy, and every reader is invited to enter this fascinating competition. Just write a letter of not over seventy words answering this question:—

What Advertisement of "Money Making Opportunities" in this issue interests you most and why?

Here are the prizes we will pay for the ten best letters answering the above question:—

First Prize	**$10.00**
Second Prize	**5.00**
Third Prize	**3.00**
And 7 Prizes of $1.00 each	**7.00**

First read every one of the "Money Making Opportunities" advertisements on pages 4 to 15. Check the ones that interest you. Then read over the ones you have checked and decide on the one that interests you most.

Then write a short letter, not more than seventy words, telling us why the advertisement you pick interests you most. Remember that ten prizes will be awarded. You have a good chance of winning one of them. Be sure to mail us your answer before July 1st. The prizes will be awarded, in the order of their merit, for the letters that are most interesting and best expressed.

The names of all the prize winners and the letters that win the first two prizes will be printed in this column in the Sept. issue. Address your prize letter to

Contest Editor
POPULAR SCIENCE MONTHLY
250 Fourth Ave., New York City

Last Month's Prize Winners

The first prize of $10.00 goes to Francis A. Ryan, of Bridgeport, Conneticut, for his letter on the advertisement of the Cincinnati Machinery Company. Here is Mr. Ryan's letter:—

Dear Sir:
The one advertisement that appealed to me especially in Popular Science this month was that of the Cincinnati Machinery Supply Company of Cincinnati, Ohio.
It impressed me so strongly first because of its freedom from exaggeration. Nowhere was I told that here was the chance of a lifetime to buy something at prices never before equaled or ever to be equaled.
Second, it solved a most difficult problem for me. Very sincerely yours,
FRANCIS A. RYAN

Kenneth Kelly, of Shelby, Michigan, wins the second prize for the following letter on the advertisement of the Freeport Manufacturing Company.

Dear Sir:
In answer to your prize winning contest on "What advertisements of 'Money Making Opportunities' in this issue interests you most, and why?" I will give you my opinion on the subject.
The advertisement that interests me most is that of the Freeport Manufacturing Company. This advertisement is not one of the kind that has an impression that the agent can get rich quick. But it does offer a good salary. And it offers the one thing that helps the agent most and that is *credit*.
Yours very truly,
KENNETH KELLY

The Third Prize goes to Carl L. Wheeler, Carthage, N. Y., for his letter on the advertisement of the Downs Publishing Co.

The winners of the other seven prizes are:

Frank J. Huekels, Charleston, Wash.; Eldon Paterson, Cadillac, Mich.; L. B. McBride, Highland Park, Ill.; Rudolph Bzak, Fairchance, Pa.; Viola M. Pope, Vernal, Utah; P. Cain, Greenville, Texas; Cecil Miner, Rippey, Iowa.

Rate 30 Cents a Word. A 10% discount is allowed on all contracts for six consecutive insertions. Advertisements intended for the Sept. issue should be received by July 5th

BUSINESS OPPORTUNITIES

TEN 2 cent stamps brings Free Particulars. Desk B. Surety Service Company, 551 Harvard St., Rochester, N. Y.

START a Business of Your Own. 97c. profit out of every $1. Opportunity of a lifetime. Success guaranteed. Articles cost less than 1c each, sell for $1. Send 25c and I will send you complete plans and enough material to bring you $20 when sold. Theodore W. Messick, Dept. 14MC, 1136 South Seventh St., Camden, N. J.

FREE Book. Start little mail order business. Pier, 976 Cortland Street, N. Y.

LEARN the collection business. Good income; quick results. Interesting booklet, "Skillful Collecting," free. National Collector's Association, Science Building, Newark, Ohio.

BECOME a Foot Correctionist. A New Profession not medical nor chiropody. All the trade you can attend to; many are making $3000 to $10,000 yearly, easy terms for training by mail, no further capital needed or goods to buy, no agency or soliciting. Address Stephenson Laboratory, 10 Back Bay, Boston, Mass.

SOMETHING new in the Mail Order Business. Starts you in business right at home. No part time, or house to house methods. Station A, Box No. 6, San Diego, California. H. N. Allison.

INCH Display Advertisement, 166 Magazines, year, $50.00. Woods Popular Service, Atlantic City.

PATENTS procured; Trade Marks Registered—A comprehensive, experienced, prompt service for the protection and development of your ideas. Preliminary advice gladly furnished without charge. Booklet of information and form for disclosing idea free on request. Richard B. Owen, 44 Owen Bldg., Washington D. C., or 41-Z Park Row, New York.

SIGNS and Showcards easily painted with Letter Patterns. Large variety of styles and sizes. Sample for stamp. John Rahn, G2433 Greenview Ave., Chicago.

USED Correspondence courses of all schools sold, rented and exchanged. List free. (Courses bought.) Lee, Mountain, East Chattanooga, Tenn.

STOP plodding! Be successful. Operate a tire repair shop. Make big profits in any locality. We teach you and furnish complete equipments, $100 up. Book of Opportunity free. Haywood's, 1306 South Oakley Avenue, Chicago.

GET money in your mail. "Lambert's Mail Order Secrets" contains successful methods never before published. Particulars free. Leon Lambert, 555-D Kaufman Bldg., Wichita, Kansas.

NEW plan, copyrighted, guaranteed, spare time, sure, quick, positive profits. First time offered. Circular free Fred Horst, Bellingham, Wash.

MAKE-SELL Your Own Goods—Formulas. Processes. Trade-Secrets. Modern Master Methods. Catalog free. C. Thaxly Co., Washington, D. C.

WE start you in business, furnishing everything; men and women, $80.00 to $100.00 weekly operating our "New System Specialty Candy Factories" anywhere. Opportunity lifetime; booklet free. W. Hillyer Ragsdale, Drawer 19, East Orange, N. J.

GOLD, Silver, and colored Sign Letters for windows, automobiles, trucks. Make them yourself with our Process and Letter Patterns. Fast sellers. Big profits. No experience. Stamp brings actual sample. Wilterding, 1144 Pleasant Street, Oak Park, Illinois.

SERIES Collection Letters that brings your money without friction. Worth dollars for 30c. Agents write. C. McKnight Agency, 105 East Juniper, Wildwood, N. J.

INCORPORATE: avoid partnership, liability and bankruptcy. Incorporating Bureau, Philip Lawrence, Huron, So. Dak.

$2.00 invested year ago returned $1,275.00. Write P. O. Box 3261, Philadelphia.

FREE booklet describes 52 plans for making $20.00 to $100.00 weekly in home or office business of your own. Downs Co., 2326 Myrtle, St. Paul, Minn.

GET out of the rut. $100 sufficient. Learn privilege trading. Dept. N. Paul Kaye, 149 Broadway, New York.

I MADE $100,000 as Real Estate Specialist. Free booklet tells how. American Business Builders, Inc., Dept. AA-347, 1133 Broadway, New York.

START small home Mail Order Business. Booklet 2c. Harvey Teeple, Decatur, Indiana.

THE Great Wheat Secret. New book showing the cause of wheat swings and how to forecast them. Unequalled method for traders, speculators, millers. Eye-opening folder free; write today. Market Forecaster Co., Dept. B., Box 174, Topeka, Kansas.

GET into line with Gilbert's House Wives' necessities, good profits easy sellers, Six Samples $1.00. Gilbert Sale Co. Box 26-K, Milford, Conn.

LEARN FURCRAFT. Big profits waiting in every community. Easily learned at home in your spare time. Get into a high grade business for yourself. Uncrowded field. No peddling nor soliciting. We teach you how. Be first. Write today for illustrated booklet. It is free. No obligation. Northwestern Fur Co. Suite S, Sunderland Building, Omaha, Nebraska.

I MADE $30 a week home. French bread-making. 15 years' experience. Free booklet tells. Ashbrook, E. 67 Marengo, Ohio.

MR. ADVERTISER: Ask today for a copy of the 'Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Avenue, New York.

More Money Making Opportunities on pages 6 to 15

Be a Cooke Trained Electrical Expert

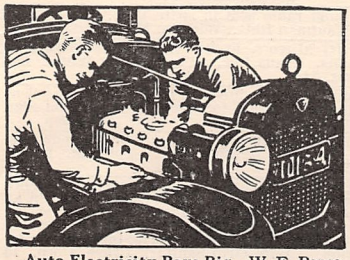
Earn $3,500 to $10,000 Yearly

Read My 16 Smashing Guarantees

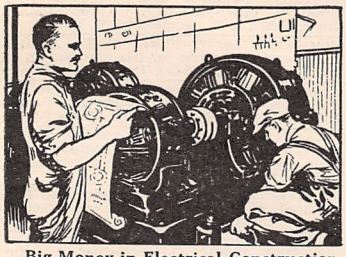
Here's the biggest offer yet—So big that I can't explain it all on this page. You don't know what guarantees are—You don't know what wonderful things I do for my students—and what I guarantee to do for you—till you get my book "The Vital Facts." Send for it now. Get the details of my 16 smashing, world beating guarantees.

The Vital Facts

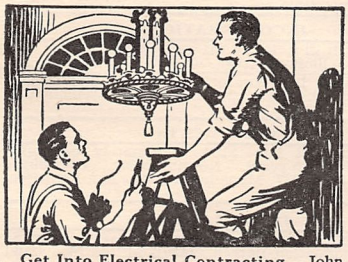
This is the book that has shown thousands of men the way to amazing pay increases. Get your Free Copy now. Learn how other men, no smarter than you have increased their pay 100%—200% and even 500% through Cooke Training. Send Coupon Now!



Auto Electricity Pays Big. W. E. Pence, Albany, Oregon, specializes in Auto Electricity and makes $750.00 a month. Was formerly a mechanic earning $30.00 a week.



Big Money in Electrical Construction. A. F. Klemz, 4449 Kerwin, Detroit, Michigan, earns over $5000 a year in Electrical Construction work. He formerly earned $5 a day.



Get Into Electrical Contracting. John Jirinec, 1133 Fourth Ave., Astoria, L. I., New York, makes $800 to $1000 a month in business for himself. He says Cooke Training is responsible for his success.

EVEN ordinary electricians are earning $10 to $12 a day and thousands of big jobs paying $70 to $200 a week are going begging for want of trained men to fill them. Electrical Experts (trained men) are needed everywhere now. Electricity—the fastest growing industry and best paying profession in the world NEEDS YOU. I will train you just like I trained the three men whose pictures you see to the left, and thousands of others. Get the details of my training and my 16 smashing guarantees.

I Will Train You at Home—in Spare Time

In my training you get my own 20 years of experience as an engineer; the knowledge and experience of 50 other noted engineers and full time and services of 10 college trained and practical engineers whom I employ to assist me in the work of training my students.

Cooke Trained Men Most Successful

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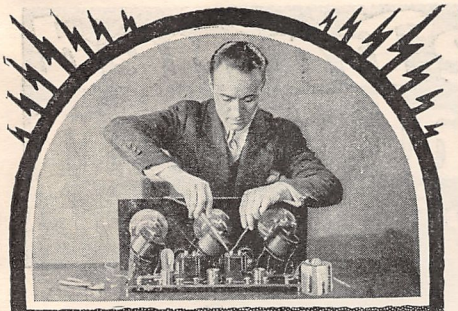

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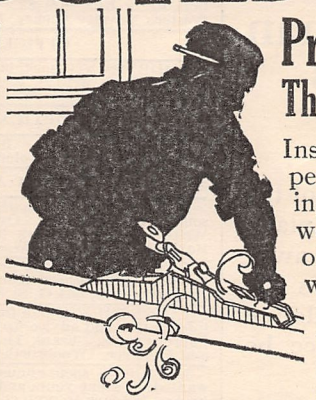

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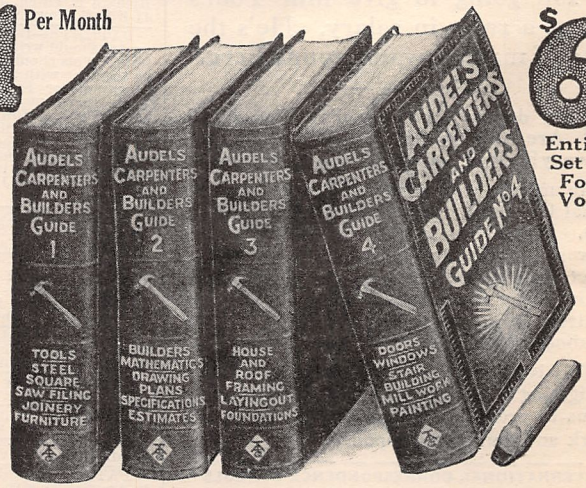

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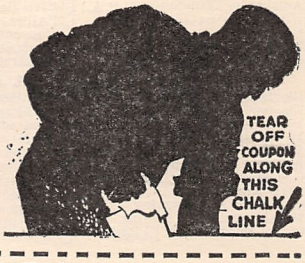

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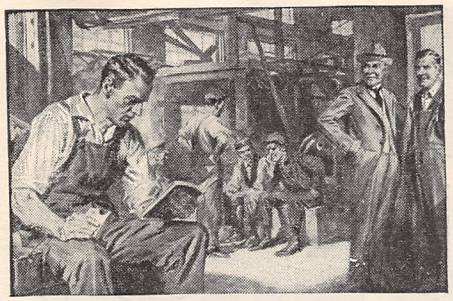

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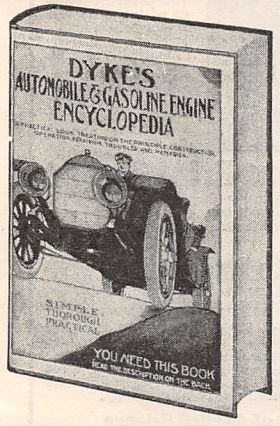

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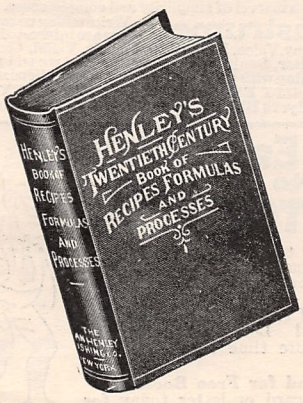

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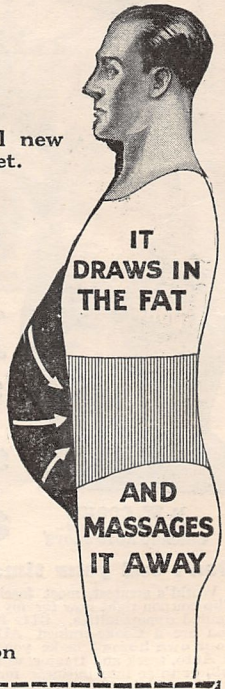

YOU can now reduce your waist from two to six inches—just by putting on this amazing belt which makes you look thinner—*at once!* Better yet, you'll be astonished to see how the fat vanishes as you wear it. Indigestion, constipation, backache, all the disorders of sagging stomach walls quickly disappear with the fat You will marvel to see how quickly you regain youthful health.

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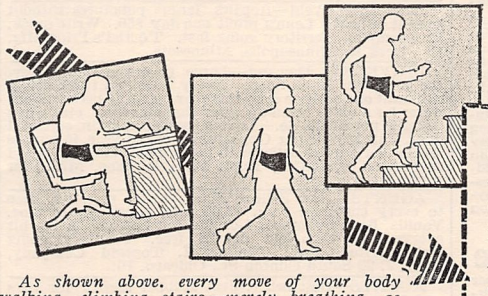

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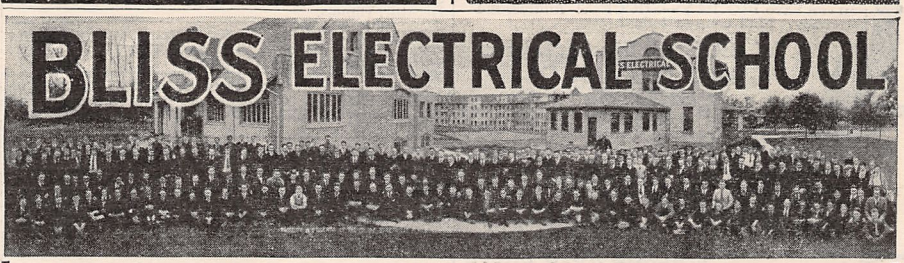

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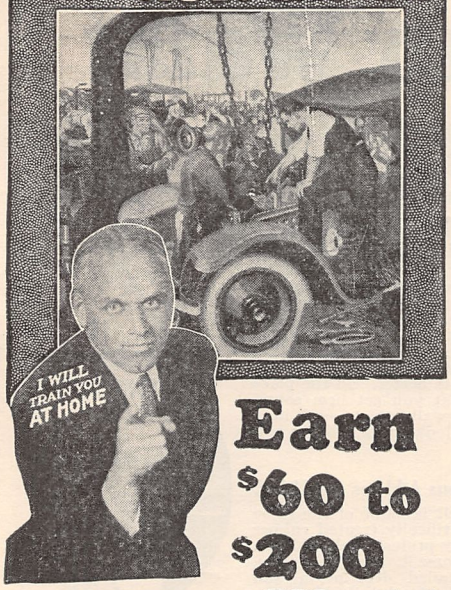

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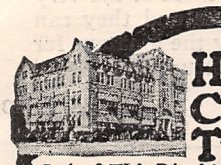

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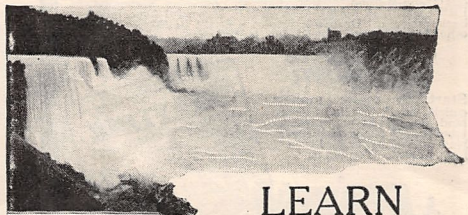

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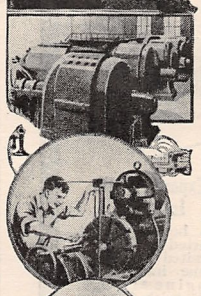

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POPULAR SCIENCE MONTHLY
225 West 39th Street, New York City

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BE A RAILWAY TRAFFIC INSPECTOR

Trained Men Wanted

Prepare for this fascinating work with assurance that *we will secure position for you*, upon graduation, paying at least $110 per month and expenses to start, or *we will refund your money*. You take no risk and you can prepare in your *spare time*.

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Ralph E. Becker: "Ten days after receiving my diploma I was given a position with a large railway company in the east. Traffic Inspection offers *steady employment* and the opportunity to travel all over the country."

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Send me, entirely free, Booklet No. *D-64* giving full particulars about course in Railway Traffic Inspection.

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McSweeny will help YOU make BIG MONEY

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You can earn $100 a week

You'd like to earn $100 or more a week—or be your own boss—wouldn't you? You can. All that I ask you to do now is simply to spend 2c—one postage stamp—and let me prove to you that this is your opportunity. Don't delay. Mail this coupon now.

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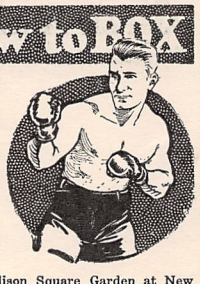
McSweeny Automotive and Electrical Training Shops, Dept. 261, 9th and Walnut Sts., Cincinnati, Ohio; 517-521 So. Lyflin St., Chicago, Ill.; 1815 East 24th St., Cleveland, Ohio. Dear "Mac": Send me free of charge full details on special summer offer

NAME_____

ADDRESS_____

SPECIAL SUMMER OFFER

Learn How to BOX



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Easy and delightful way to learn good English—at home—without RULES. Spelling, grammar, punctuation, and expression, taught in 10 minutes a day. Ability to use clear, forceful, and convincing English would undoubtedly bring you MORE MONEY—MORE POWER—and SOCIAL SUCCESS. Write to-day for Free Book "How to Speak and Write Good English" and 10 minute test with answers. Address.
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213 W. Como Avenue, COLUMBUS, O.

Money Making Opportunities

SALESMEN AND AGENTS WANTED

NOTHING LIKE THIS: Sample $3.00, retails $15.00; write, Miracle Laboratories, Fellows, Calif.

DUSTLESS Sponge Cloth, New Invention. (1) Rub—Dusts, Cleans and Polishes Automobiles, Furniture, Pianos. Retails 50c.—Costs 16c. Sample Free. NuLife Sponge. Hartford, Conn.

AGENTS—Make a dollar an hour. Sell Mendets, a patent patch for instantly mending leaks in all utensils. Sample package free. Collette Mfg. Co., Dept. 467, Amsterdam, N. Y.

SALESMEN sell sales and order books, auto, reg. rolls and bill ladings. Large demand. Liberal commission. Wirth Sales Book Co., Dept. PS, Chicago.

EARN $10 daily silvering mirrors, plating and refinishing metal ware, headlights, chandeliers, bedsteads. Outfits furnished. F. Decie Laboratories, 1133 Broadway, New York.

AGENTS—Write for free samples. Sell Madison "Better-Made" Shirts for large Manufacturer direct to wearer. No capital or experience required. Many earn $100 weekly and bonus. Madison Mfgrs., 511 Broadway, New York.

WE start you without a dollar. Soaps, extracts, perfumes, toilet goods. Experience unnecessary. Carnation Co., Dept. 21, St. Louis.

STAMMERING

ST-TUT-T-T-TERING and stammering cured at home. Instructive booklet free. Walter McDonnell, 59 Potomac Bank Building, Washington, D. C.

STAMPS AND COINS

NEWFOUNDLAND Caribou 4 and 5 cents, catalog 30 cents, packet of over 50 different stamps, catalog $1.07, scale perforation guage, ruler, price lists, all for 9 cents to introduce approvals. Fennell Stamp Co. Dept. C. St. Louis, Mo.

50,000 COINS, medals, paper money. Lists free, Nagy, 8K South 18th St., Philadelphia, Pa.

1,000 United States and Foreign Postage Stamps mixed for Stamp Collectors 25 cents. C. W. Parker Meriden, Conn.

100 different European—10c. 60% approvals. Feeser's Stamp Co., 916 Maple St., Lebanon, Pa.

FREE stamps. Request approvals. F. Hornischer, 209 Wendell St., Chicago.

UNITED STATES 20c piece 50c. Bargain price list free. M. Arcy, Box 483, Muskogee, Oklahoma.

25 PRECANCELS—and copy—"Badger's Precancel Partner" 4c to Approval Applicants. "Badger," Brooksville, Florida.

STAMPS, 100. All different, 3 cents. Lists free P. S. Quaker Stamp Co., Toledo, Ohio.

1,000 DIFFERENT stamps $1.00. Fred Onken, 630 79th Street, Brooklyn, N. Y.

100 DIFFERENT stamps free to popular approval applicants; postage 2c. Christensen, 124 Second Street, Milwaukee, Wisconsin.

1000 DIFFERENT Stamps, wonderful quality, $1.00. C. E. Nickles. 3002 Rodman St., Washington, D. C.

OLD Coins. Large Spring Selling catalogue of coins for sale free. Catalogue quoting prices paid for coins, ten cents. William Hesslein, 101B Tremont Street, Boston, Mass.

500 MIXED Stamps from 40 different Countries, Australia, North, Central, and South America, Russia, Africa, China, Japan, British, French, Colonies, War issues, etc., also 500 stamp hinges, pocket stock book, perforation gauge, and 3-United States stamps issued before 1872, all for 25c. Biggest bargain ever offered. Satisfaction guaranteed or money back. Hussman Stamp Co., Dept. P.S., St. Louis, Mo.

17 VARIETIES Bulgaria stamps, 20 cents. List of 7,000 low-priced stamps free. Chambers Stamp Company, 111 C. Nassau Street, New York City

CALIFORNIA gold $\frac{3}{4}$ size, 27c.; $\frac{1}{2}$ size, 53c. White cent and catalogue, 10c. Norman Schultz, Colorado Springs, Colorado.

$5.00 FOR 10c.—200 all different (mostly unused) from Ireland, Newfoundland, Jamaica pictorial, etc., triangle set, airplane set, small album and bargain lists—all for 10c to new approval applicants. Victoria Stamp Co., London, Canada.

100 DIFFERENT New Europes Free to Applicants for our Net Approvals, Postage 2c. Badger Stamp Co., Milwaukee, Wis.

OLD Foreign Coin sent Free. Cornish Company Schenectady, N. Y.

UNITED STATES and Foreign money. Medals. Catalogue and Villa Bill, 10c. Alexis Mengelle, Colorado Springs, Colorado.

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CHICAGO Technical College offers short, intensely practical courses in Drafting and Engineering—civil, mechanical, electrical, structural—Architecture, Building, Construction, Plan Reading, etc. Courses fitted to your needs. No time wasted. Instructors are experts. Graduates in demand at big salaries. Opportunities for part-time work while studying. Day and evening classes. 22nd year. Enter any time. No special preliminary training required. Low tuition—easy terms. Write for 52-page illustrated Blue Book, describing opportunities open to our graduates. Chicago Technical College, 23 Chicago Tech. Building, Chicago.

TYPEWRITERS AND SUPPLIES

TYPEWRITERS all makes. Save one-half. Thoroughly rebuilt in our factory by the famous "Young Process," Fully guaranteed. Free trial. We handle all standard makes. Cash or sold on easy terms. Write for Catalog. Young Typewriter Co., Dept. 5767, Chicago. Ill.

UNDERWOOD Typewriters—only $3.00 down. Easy monthly payments. Low prices at less than manufacturers. 10 days' free trial. Rebuilt, all worn parts replaced. Just like a new machine. 5-year guarantee. Write for big free catalogue, B-370. Shipman-Ward Mfg. Co., B-370 Shipman Bldg., Chicago, Ill.

WANTED

WANTED—Representatives in every factory in the United States. Popular Science Monthly, 250 Fourth Ave., New York.

DETECTIVES needed everywhere. Experience unnecessary. Particulars free. Write, George Wagner, former Government Detective, 1968P Broadway, N. Y.

More Money Making Opportunities on pages 4 to 12

Every Ten Years A Fortune Escapes From The Average Income

Far bigger than you imagine is the fortune that lies hidden in the modest income. Far easier than you expect is the process of accumulating wealth, if you go about it in the right way.

TEN years from today, you will either have a comfortable fortune, or you will have allowed it to slip, unnoticed, from your income. The miracle of 6½% invested and reinvested the definite Forman way takes your future out of the hands of chance. The surprising fact is that you can actually make sure of financial independence by buying your fortune month by month.

Don't think that the ease and luxury of financial independence at fifty are beyond you. We have just published a remarkable book, on the Science of Fortune Building. See, in this free book, how money doubles itself in a little more than 10 years. Find out how big the fortune is that will either escape or accumulate from your income during the next ten years. This book not only tells how much to put by to reach your financial goal, but also tells how to put it by without hardship.

Summed up in this new book is the financial experience of 40 years for big and little investors, without a loss to any customer of either principal or interest. Be guided by this free book whether your yearly income is $2,000 or $20,000—whether you have only your savings to invest or a large estate to administer. It places your financial future clearly before you—to make of it what you will.

Ask for booklet No. A-837

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First Mortgage Real Estate Bonds

40 Years Without Loss to a Customer

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George M. Forman & Company,
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Chicago, Illinois

Send me a copy of your booklet A-837, "The Science of Fortune Building," which contains Tested Plans for Building a Fortune.

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Buyers of good tools, the kind of tools that give husky, long-lived service, will want V & B Vanadium Hammers and V & B Unbreakable Planes for their kits.

They're two thoroughbreds that will give you years of service.

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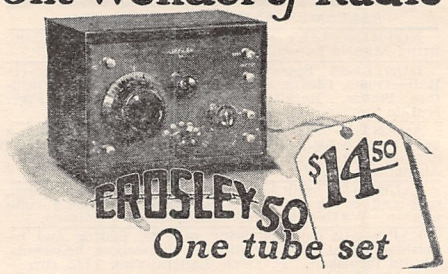
VAUGHAN & BUSHNELL MANUFACTURING COMPANY
Makers of Fine Tools
2114 Carroll Ave ~ ~ Chicago, Ill. U. S. A.

The Wonder of Radio



This is the latest refinement of the marvelous set that enabled Leonard Weeks of Minot, N.D. to catch the messages of MacMillan's North Pole expedition when sets costing ten times as much failed.

In this set Crosley has developed the famous Armstrong regenerative circuit. This circuit does with one tube what it takes 3 tubes to do in others.

This set has been known to bring in stations from all over the country. It is simple and easy to operate. With accessories the total cost should be under $25.00. Crosley keeps the cost down with his "radio-for-the-millions" ideas in production.

Recent letters from enthused owners of the Crosley one-tube 50 report good reception at these distances:

Mrs. J. E. Martin at East Palestine, O. hears KGO at Oakland, Calif.

O. W. Bryant at Sunset, Texas gets WLW at Cincinnati, KDKA at Pittsburgh and Hollywood, Calif.

L. R. Pratt, Hammond, Ind. hears 5NO, New Castle, England.

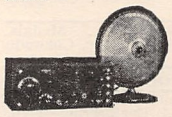
Eugene Barnhouse at Brookfield, Mo. hears Montreal and Winnipeg, Canada.

Paul J. Hall at Osceola, Neb. hears 2LO at London, England.

$18.50
2-Tube Crosley 51
Same as Crosley 50 with additional tube. Local and nearby stations on loud-speaker and distance up to 1500 miles under average conditions. Much greater range with phones.

Crosley 51 Portable

Crosley Musicone
A marvelous new development of loud-speaking principles. $17.50.



3-Tube Crosley 52—$30
A greater range on loud-speaker. Three tubes, wet or dry batteries. Consistent loud-speaker range 1500 miles or more.

Crosley 52 Portable $35

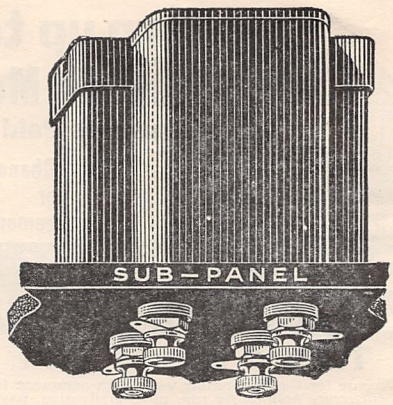
Prices quoted above do not include accessories. Add 10 per cent west of Rocky Mountains.

Crosley manufactures receiving sets which are licensed under Armstrong U.S. Patent No. 1,113,149 and priced from $14.50 to $65, without accessories.

Crosley owns and operates station WLW, Cincinnati, the first remotely controlled super-power broadcasting station

The Crosley Radio Corporation
Powel Crosley, Jr., President
717 Sassafras Street
Cincinnati

CROSLEY RADIO
Better~Costs Less



Sub-Panel Mounting Type Thordarsons Now on Sale

They permit a neater assembly, the shortening of leads and the concealing of wiring—as in factory built sets. Same ratios—same prices—as standard type Thordarsons. If dealer cannot supply, order from us.

"Best by Competitive Test," says Zenith

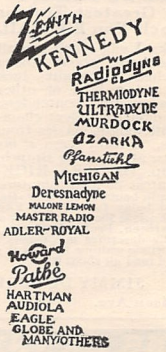
"In the early Fall of 1923 we made numerous experiments of all existing types of transformers and finally adopted Thordarsons as the best by competitive test. The immediate result was improvement in the tone quality of our sets and comparative freedom from trouble due to the uniformity of your transformers.

"A radio set is only as good as the transformers that are used therein. We can, therefore, truthfully say that the superiority of Zenith sets is due to the superiority of Thordarson Transformers. We congratulate you upon the good product you are manufacturing."

—from a letter dated February 28, 1925, written by Zenith Radio Corporation, Chicago.

Unconditionally Guaranteed

THORDARSON
Super AMPLIFYING TRANSFORMERS
Standard on the majority of quality sets



Types and Prices

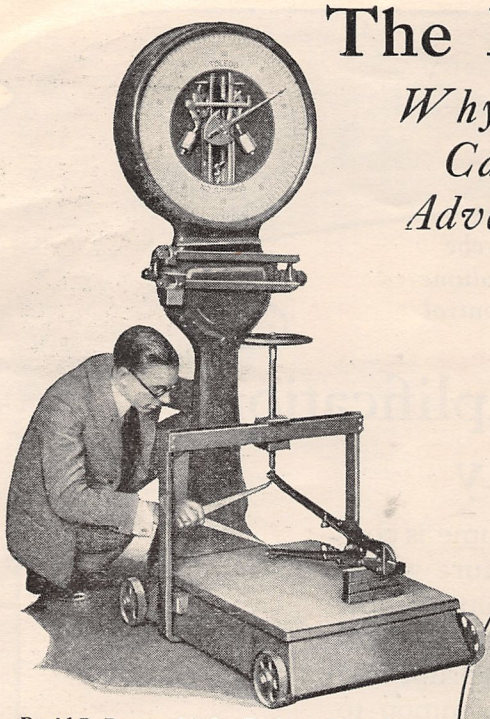
Ⓘ Thordarson "Super" Audio Frequency Transformers are to be had in three ratios: 2-1, $5; 3½-1, $4; 6-1, $4.50. Thordarson Power Amplifying Transformers are $13 the pair. Thordarson Interstage Power Amplifying Transformer, $8. Write for latest hook-up bulletins—*free.*

THORDARSON ELECTRIC MFG. CO.
Transformer Specialists since 1895
World's Oldest and Largest Exclusive Transformer Makers
Chicago, U. S. A.

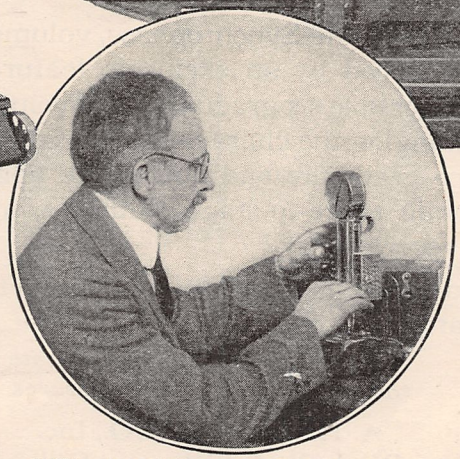
Australian Representatives: Walnart Electric Mfg. Co., Ltd., Sydney

The Men Behind the Tool Tests

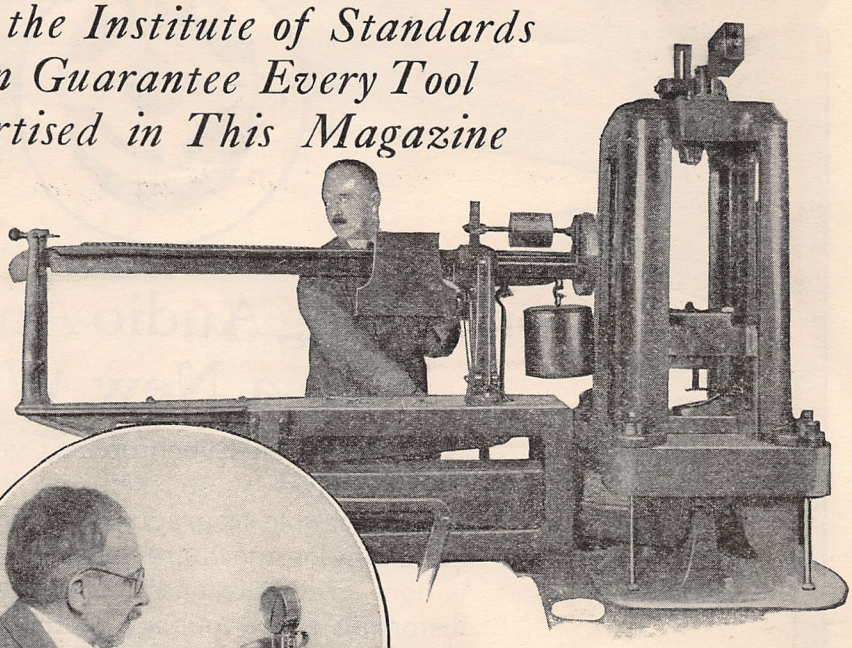
Why the Institute of Standards Can Guarantee Every Tool Advertised in This Magazine



David B. Porter, Ph.B. Professor Porter is here employing one of the many novel testing arrangements devised to determine the efficiency of tools offered for advertisement in the pages of Popular Science Monthly



C. Theodore Schwarze, B.S., C.E. An authority on steel, has had a wide experience that includes testing work for the U. S. Government and for well known railroads



Carlos deZafra, M.E. Twenty-two years of industrial experience, during which he rose from mechanic to an important executive position, has given Mr. deZafra a practical basis for his present tests for the Institute

THE efficiency of a tool is dependent largely on the quality and suitability of the steel employed and, for this reason, Prof. C. Theodore Schwarze, who is an authority on steel, has been secured by the Popular Science Institute of Standards to take charge of the tests for strength of tool material.

The steel in every tool advertised in POPULAR SCIENCE MONTHLY has been tested for strength by Professor Schwarze after the tool has undergone many rigid tests for wearing ability, construction, and similar important requirements.

Since receiving the degrees of Bachelor of Science and Civil Engineer from Lehigh University, Professor Schwarze has been active in testing work. While with the New York Central Railroad, he determined standards for tools manufactured and used by that organization.

During the war, Professor Schwarze was engaged in Ordnance Material tests at Cooper Union. Steel that went into guns and shells was tested for strength and Professor Schwarze's ability and experience in this line of work proved valuable to the government.

Professor Schwarze is an active member of the American Society for Testing Materials and also of the American Society of Civil Engineers.

IN DEVISING tests for tools, the chief problem is to duplicate working conditions so that the tool being tested artificially receives years of wear in a few hours.

Professor David B. Porter is responsible for many of the original test methods that the Popular Science Institute of Standards now is employing to determine the efficiency of tools offered for advertisement in POPULAR SCIENCE MONTHLY.

While at the Sheffield Scientific School at Yale, Professor Porter pursued the courses in Mechanical Engineering. His theoretical knowledge along this line was later put to practical use when he was staff engineer for one of the best known small-tool manufacturers.

Professor Porter is now advisor to this tool concern and assistant professor of Industrial Engineering at New York University. He is a member of the American Society of Mechanical Engineers and the Society of Industrial Engineers.

MR. CARLOS DEZAFRA is Recording Secretary and he also performs many of the tool tests made by the Popular Science Institute of Standards.

After graduating as Mechanical Engineer from New York University, Mr. deZafra had 22 years of practical industrial experience, rising from mechanic to important executive positions in industrial corporations.

In the course of this experience, he not only made actual use of tools under shop conditions, but later, in order to standardize the tools and equipment used throughout a large plant, was a member of its Standardization Committee.

Mr. deZafra is now faculty lecturer in Engineering at New York University. He is author of numerous papers on engineering subjects, and was recently app ointed as a major in the Ordnance Reserve, U. S. A.

With the tool tests of the Popular Science Institute of Standards in the competent hands of such men as Professors Schwarze and Porter and Mr. deZafra, there can be no question of the reliability of the products approved by this organization.

POPULAR SCIENCE *Monthly*

Guarantee

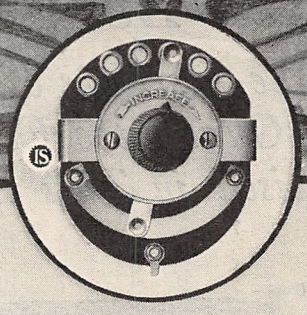
The above seal on an advertisement indicates that the products referred to have been approved after test by the Popular Science Institute of Standards.

Popular Science Monthly guarantees every article of merchandise advertised in its columns. Readers who buy products advertised in Popular Science Monthly may expect that these products will give absolute satisfaction under normal and proper use. Our readers in buying these products are guaranteed this satisfaction by Popular Science Monthly.

THE PUBLISHERS.

Send for List of Approved Products

POPULAR SCIENCE MONTHLY will be glad to furnish a list of Radio and Tool Manufacturers whose products have been approved by the INSTITUTE after rigid laboratory and practical tests.



Grebe Volume Control

Controlling Audio Amplification in a New Way

WITH the Synchrophase, volume is controlled by an exclusive feature which makes possible six graduations of volume without changing the character of the sound. This is done gradually and not by the abrupt and distorting stage-to-stage method common to most receivers.

Sound can thus be modulated at will to please the ear.

Ask your dealer to demonstrate this and other Grebe features

A. H. GREBE & CO., Inc.
Van Wyck Blvd., Richmond Hill, N. Y.
Western Branch: 443 So. San Pedro Street, Los Angeles, Cal.

The GREBE SYNCHROPHASE
TRADE MARK

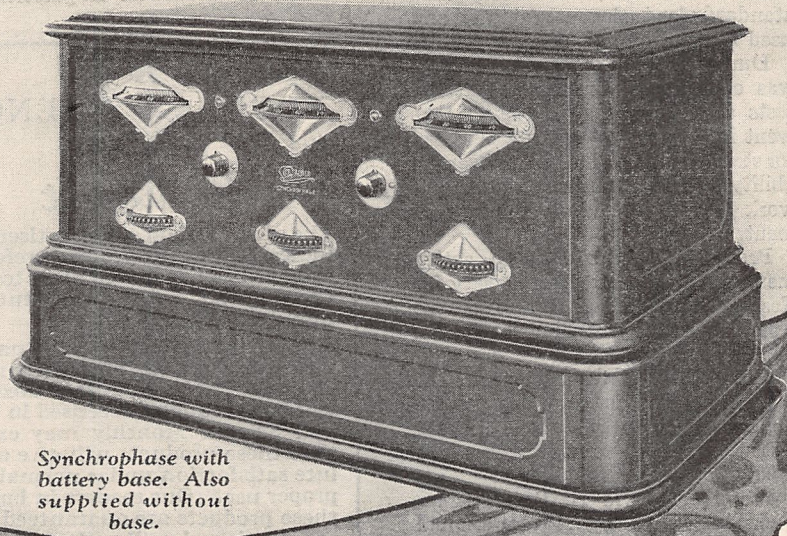
This company owns and operates station WAHG

Exclusiveness is a virtue only as it benefits others.

Doctor Mu

GREBE RADIO
TRADE MARK
Reg. U. S. Pat. Off.

All Grebe apparatus is covered by patents granted and pending.



Synchrophase with battery base. Also supplied without base.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 17.

POPULAR SCIENCE MONTHLY
SUMNER N. BLOSSOM, Editor
July, 1925

$10,000 in Cash Prizes

You Can Start Now in Our Fascinating "What's Wrong" Contest

IF YOU have not yet met John and Mary Newlywed, you are missing the most fascinating, worth-while contest of the year—POPULAR SCIENCE MONTHLY's "What's Wrong" Prize Contest; $10,000 for the winners!

This sensational offer was announced last month, but you still have an equal chance with every one else to win one or two, or even four or five, of the hundreds of cash prizes to be awarded during the four months of the contest. Until June 30, you can submit answers in the first of the monthly contests.

The first of the answers coming in indicate that folks are catching the idea in fine shape; are having a lot of fun finding out the mistakes that John and Mary, and the artist who created them, are making. Those who already have solved the first set can start right in finding "what's wrong" in the pictures on the next two pages.

And, if you have not entered yet, here's the way:

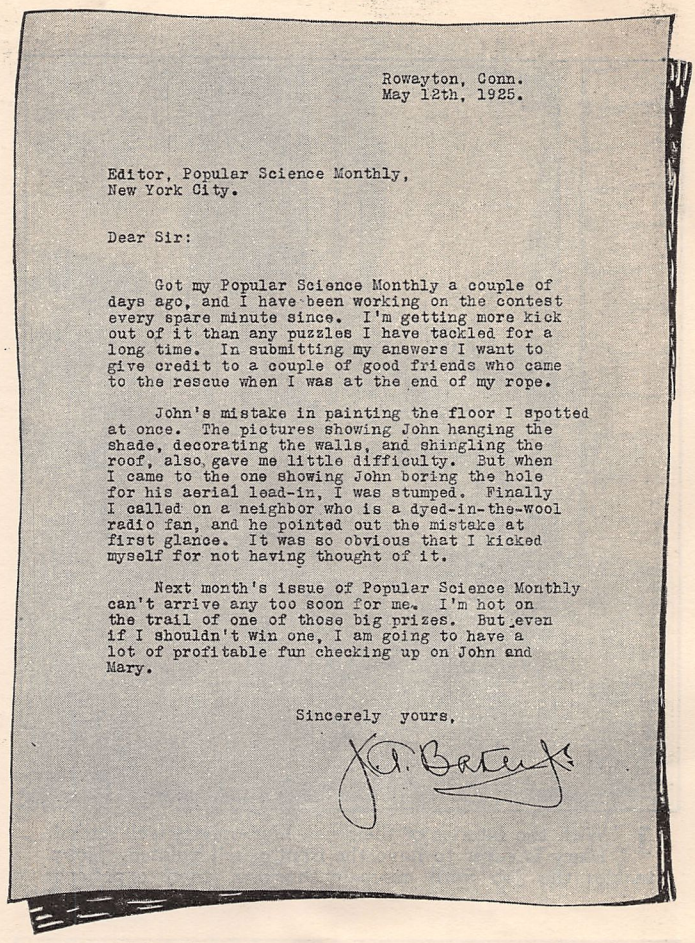
First, get a copy of the June issue of POPULAR SCIENCE MONTHLY or send a stamped, self-addressed envelope to the Picture Contest Editor, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York City, for a free set of the pictures published last month.

Second, get the idea of the contest. It is simple. John and Mary Newlywed have moved into a home that is not exactly new, and is in need of some minor repairs. They have an endless amount of enthusiasm, but little experience in doing the odd jobs about the house, so of course they make plenty of mistakes. We are telling the story of these mistakes in a series of 32 pictures, eight of the pictures appearing in each of four successive issues.

IN EACH picture John or Mary is seen hard at work at some homemaking job. Always there is something wrong in the way the job is being done. In addition, our artist has drawn one thing in each picture incorrectly.

What you are to do is to tell us just what John or Mary is doing wrong in every picture and why it is wrong; also what mistake the artist has made.

Have you determined what is wrong in the picture on the cover of this issue? This picture was printed as an example to give you a good start in the contest. What is John doing wrong? Obviously he is varnishing a table in the smoke from the backyard incinerator. If you don't already know, you easily can find out why this is wrong and how it should be done.



Rowayton, Conn.
May 12th, 1925.

Editor, Popular Science Monthly,
New York City.

Dear Sir:

Got my Popular Science Monthly a couple of days ago, and I have been working on the contest every spare minute since. I'm getting more kick out of it than any puzzles I have tackled for a long time. In submitting my answers I want to give credit to a couple of good friends who came to the rescue when I was at the end of my rope.

John's mistake in painting the floor I spotted at once. The pictures showing John hanging the shade, decorating the walls, and shingling the roof, also gave me little difficulty. But when I came to the one showing John boring the hole for his aerial lead-in, I was stumped. Finally I called on a neighbor who is a dyed-in-the-wool radio fan, and he pointed out the mistake at first glance. It was so obvious that I kicked myself for not having thought of it.

Next month's issue of Popular Science Monthly can't arrive any too soon for me. I'm hot on the trail of one of those big prizes. But even if I shouldn't win one, I am going to have a lot of profitable fun checking up on John and Mary.

Sincerely yours,

POPULAR SCIENCE MONTHLY'S great new contest is open to everybody, everywhere. All you have to do is to find "what's wrong" in the 32 puzzle pictures, 8 of which are on the next two pages. Each monthly set of pictures is a complete contest in itself and, in addition, a part of the Grand Prize Contest. The letter above, received with one of the first entries, shows how one reader got assistance from his friends. Don't hesitate to ask yours for help

Now for the observation test. What about the shadows? Is it right that the shadow cast by the varnish can should fall in a direction opposite to that of all other shadows?

In all, there are four complete monthly contests; eight pictures in each. For the best answers in each of the monthly contests we are awarding $1000 in cash prizes— a total of $4000. In addition, we are awarding $6000 in grand prizes for the best answers covering all of the 32 pictures shown in all of the four contests.

Now that you have the idea, you are ready to solve the eight pictures in the June contest. Having done this, you can tackle this month's contest pictures, which you will find on the next two pages.

The judges of all contests are:

Prof. Collins P. Bliss, Director of the Popular Science Institute of Standards and head of the Department of Mechanical Engineering at New York University; Dr. Hazen G. Tyler, Associate Director of the Popular Science Institute of Standards and Associate Professor in charge of Experimental Engineering, New York University; Alexander Senauke, M.E., Radio Engineer of the Popular Science Institute of Standards.

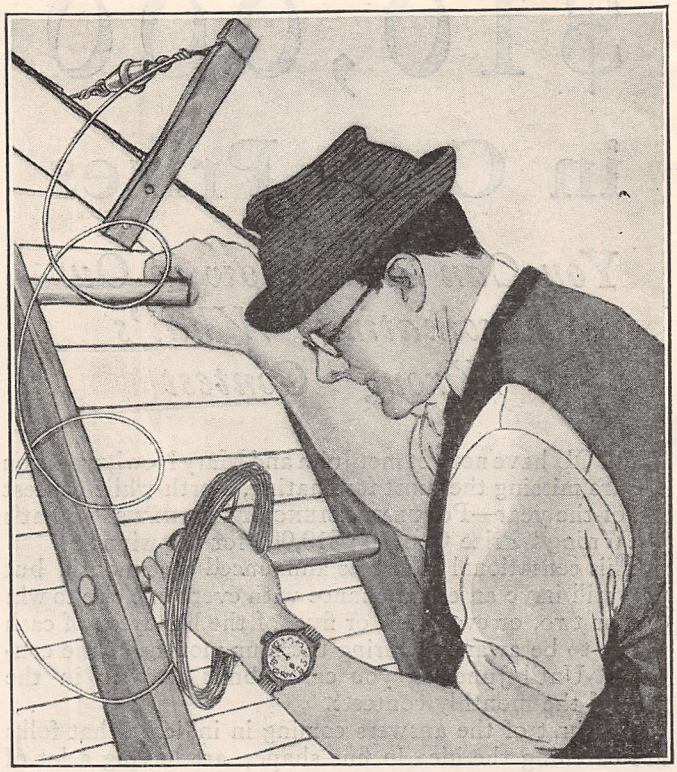
RULES AND COMPLETE LIST OF PRIZES WILL BE FOUND ON PAGE 22

A New Test for Your Alertness and Observation

What's Wrong in

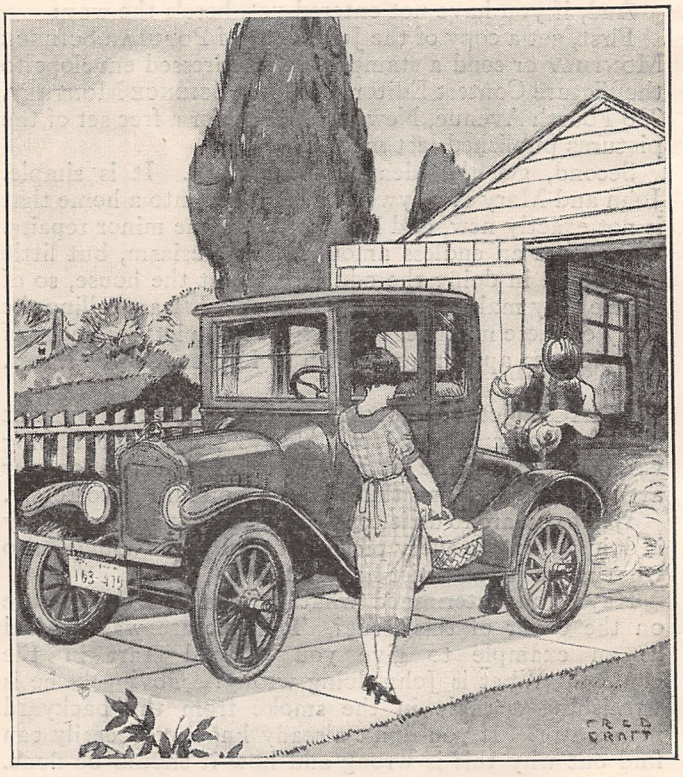
In Each John Is Doing Something Made One Error

1. With the interior of their new home pretty well settled, Mary is eager to have the front porch painted. John, tackles the job with more enthusiasm than experience



2. A balky radio set next claims John's attention. Although a novice, he moves his aerial. Here he is climbing down from the roof, confident that *now* his receiver will work

3. Mary says that the large dead tree in the side yard is unsightly. So John, no woodsman, but energetic and willing, gets out his ax and sets vigorously to work to remove it



4. After starting the new Ford coupé one morning, John remembers his "gas" supply is low. Fortunately he has a reserve, and as he uses it he is pleased with his foresight

These Pictures?

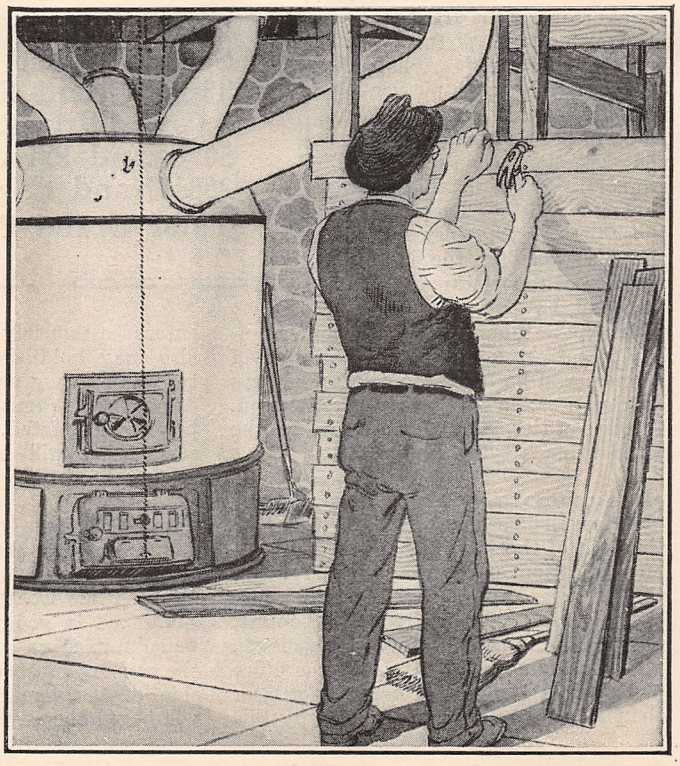
Wrong, and in Each the Artist Has in the Drawing

Can You Find Two Mistakes in Each One?

5. John is eager to test a little camera he has purchased. Despite his inexperience, he boasts, as he poses Mary for a snapshot, that "anybody can take pictures nowadays."

6. Disturbed by mosquitoes, John and Mary agree that the broken window-screen must have new wire. John never has made a screen, but tackles this job with a will

7. Mary, economical soul, insists on the wisdom of filling the coalbin in summer. The truckman unloads the coal in the street. John, not to be outdone in economy, carts it in



8. Mary's next suggestion is for a vegetable bin in the cellar. John, eager to use his new tools whenever he can, shares her enthusiasm and here is shown building the bin

Have You Entered *Our Great $10,000 Contest?*

The Rules in This Remarkable Competition

1. Every month for four months, beginning in the June issue, POPULAR SCIENCE MONTHLY is printing a set of pictures of John and Mary Newlywed. Each of these pictures shows John or Mary doing some simple "job about the home" in an incorrect way. And, in addition, there is a deliberate error in the drawing of each picture. You are to tell us what two things are wrong in each picture and why they are wrong.

2. There are four complete monthly contests, each of eight pictures. The first was in last month's issue, one is in this issue, and one will appear in each of the August and September issues of this magazine. In addition, there will be a Grand Prize Contest covering all of the 32 pictures printed in the four months of the contest.

HOW TO COMPETE

3. In connection with each picture these questions must be answered: "What job is being performed improperly in this picture and how should it be done correctly? And (2) What error has the artist made in drawing the picture and why is it wrong?" A list of errors—two for each picture—is in the custody of the judges and will be used as a basis for the selection of the prize-winners. Prizes in all of the contests will be awarded to those persons who answer best the questions for the largest number of the pictures. It is provided, however, that as between contestants having the same number of correct solutions the selection of winners will be based upon (1) accuracy; (2) clearness; and (3) skill of presentation. In cases of ties, a duplicate award will be given to each tying contestant.

4. Answers to each set of eight pictures must be received not later than the thirtieth of the month following the date of publication of the magazine in which the pictures appear. Thus, to insure consideration in this month's contest, answers to the eight pictures in this issue, published June 10, must reach the office of POPULAR SCIENCE MONTHLY not later than July 30. Pictures received by this date will be entered automatically in the Grand Prize Contest also. Contestants, however, may enter additional answers later for the Grand Prize Contest, or may enter for the Grand Prize Contest any time before September 30, without having entered a monthly contest. Contestants also may hold the answers to all pictures until they have a complete set of 32 before submitting the answers, it being stipulated, however, that no such entry will be received after September 30.

5. Contestants may submit as many answers as they wish for pictures in either the monthly contests or in the Grand Prize Contest, but each must be submitted in good faith. Answers may be submitted on any kind of paper, but the writing must be legible and on one side of the paper only. Each picture will be numbered plainly and contestants must attach to their answers either the corresponding picture cut from the magazine or the number of the picture. The winning of one or more monthly prizes will not bar the winner from winning a Grand Prize, if he should submit answers.

You May Win One or More of These Big Prizes

POPULAR SCIENCE MONTHLY will award $10,000 in 580 cash prizes for the best answers submitted in this great contest. The cash prizes in each of the four monthly contests will be as follows:

First Prize	$500
Second Prize	$100
Third Prize	$50
5 Prizes, $10 each	$50
60 Prizes, $5 each	$300
Total, four months	**$4000**

In addition, cash prizes in the Grand Contest will be paid as follows:

First Grand Prize	$2500
Second Grand Prize	$1000
Third Grand Prize	$500
5 Grand Prizes, $50 each	$250
50 Grand Prizes, $10 each	$500
250 Grand Prizes, $5 each	$1250
Total Grand Prizes	**$6000**

6. All entries should be addressed to the Picture Contest Editor, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York City. Name and address of the entrant must be written plainly on each entry. An entry with insufficient postage will not be received. The publishers cannot be responsible for delay, loss, or non-delivery of entries. No contribution entered in this contest will be returned.

ANNOUNCEMENT OF WINNERS

7. Prize-winners in this month's contest will be announced in the December issue of POPULAR SCIENCE MONTHLY, published November 10. Prize-winners in the August contest will be announced in the January number, and so on. The names of the winners of Grand Prizes will be announced and the correct solutions published as soon as possible after the close of the final month's contest.

8. You pay nothing. Just prove your knowledge and observation. You need not purchase POPULAR SCIENCE MONTHLY to compete. You can borrow a copy from a friend or examine one at any of the offices of POPULAR SCIENCE MONTHLY or at public libraries free of charge. These contests are open to everybody, except employees of POPULAR SCIENCE MONTHLY and the Popular Science Institute of Standards and their families. The officials of the Popular Science Institute of Standards will act as judges and their decision will be final. Acceptance of these rules is an express condition of each entry.

See pages 20 and 21 of this issue for the second set of pictures in this remarkable contest. Additional sets of pictures, each offering in itself a complete contest, will be published in the next two issues of POPULAR SCIENCE MONTHLY.

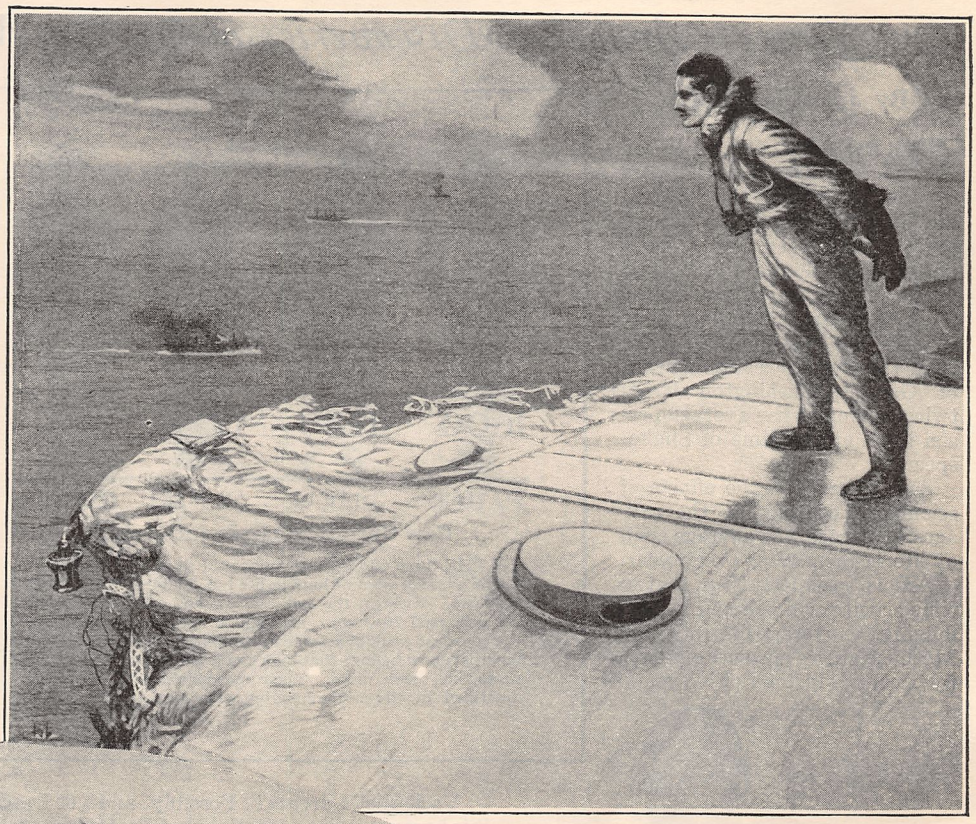
PICTURES IN THE JUNE CONTEST WILL BE SENT TO YOU ON REQUEST

Riding the Top of His Battered Ship

How a Young Officer Saved the Storm-Tossed Runaway, R-33

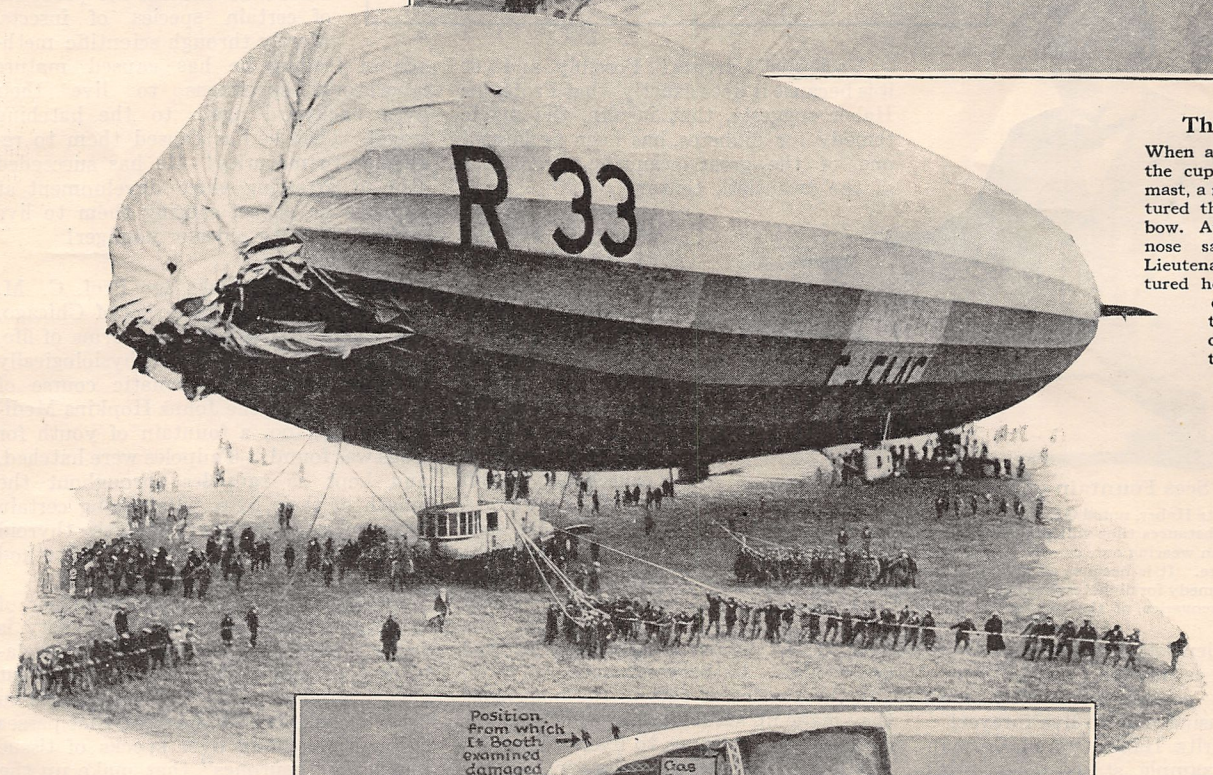
IN ALL the history of aviation there have been few more heroic figures than that of Lieut. R. S. Booth, daring young commander of the runaway R-33, the huge British dirigible that recently broke away from its mooring-mast at Pulham, England. His battered ship floundering helplessly in the teeth of a hurricane, he struggled along the top of the big bag, inspected the damage and directed repairs. This breathless moment is thrillingly pictured in the accompanying drawing.

Two minutes after the R-33 had torn away the cup of her mooring-mast, her engines were going and her crew of 21 men was heading her into the wind. For 30 hours, across the North Sea to Holland and back, they waged a desperate battle with the storm. Finally, after nerve-racking adventures that recalled the experiences of the crew of the American airship, *Shenandoah*, when she broke away from her mast at Lakehurst, N. J., in January, 1924, the dirigible was brought safely home.



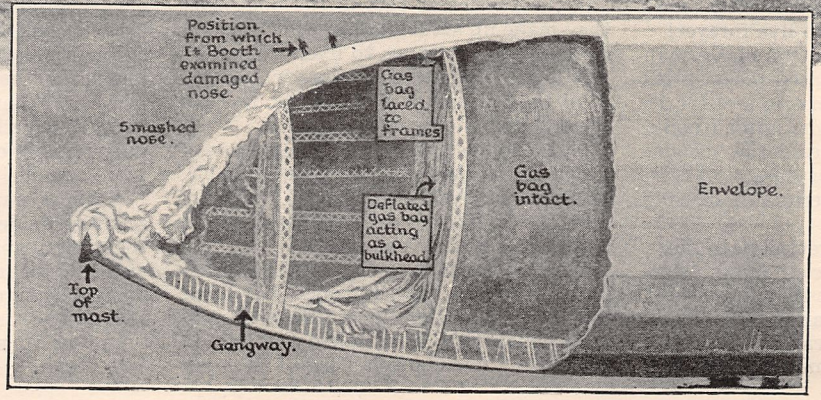
The Runaway

When a great gust broke the cup of the mooring-mast, a mass of steel punctured the gas bag at the bow. At once the airship's nose sank precariously. Lieutenant Booth is pictured here inspecting the damage. Notice that the mooring-cup still clings to the nose of the ship



Safely Home!

This remarkable photograph shows the R-33, her nose smashed by the wind, as she appeared on her return to Pulham, England, after being blown across the North Sea. When the ship broke away from the mooring-mast, the gas bag in the first of her eight sections was ripped open and collapsed. The second section was badly damaged



Saved by Patches

Heroic action of four men who climbed up the narrow girdering of the ship and laced the torn gas bag to top portions of the framework was probably all that saved the R-33 from disaster. The diagram at the left shows how this laced bag served as a screen or bulkhead to protect the second gas bag, which luckily remained intact

Is Death Really Necessary?

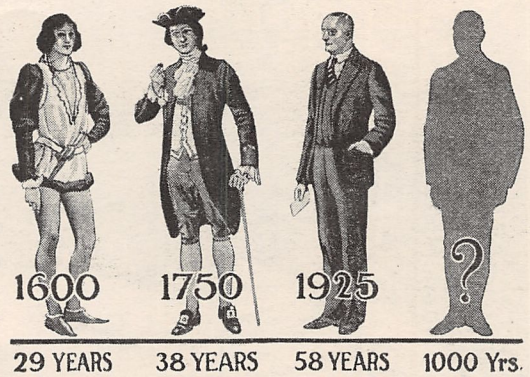
Scientists Foresee an Era when Men Will Live a Thousand Years—Amazing Discoveries about the Mystery of Life

By John E. Lodge

PRESENT-DAY man, on the average, lacks 12 years of achieving the Biblical life span of "three score and ten." That is to say, a baby born today should live for 58 years. That may not strike most of us as a "ripe old age" exactly, yet it is 20 years more than the average contemporary of George Washington lived; twice as long as the average person lived at the time of Shakespeare.

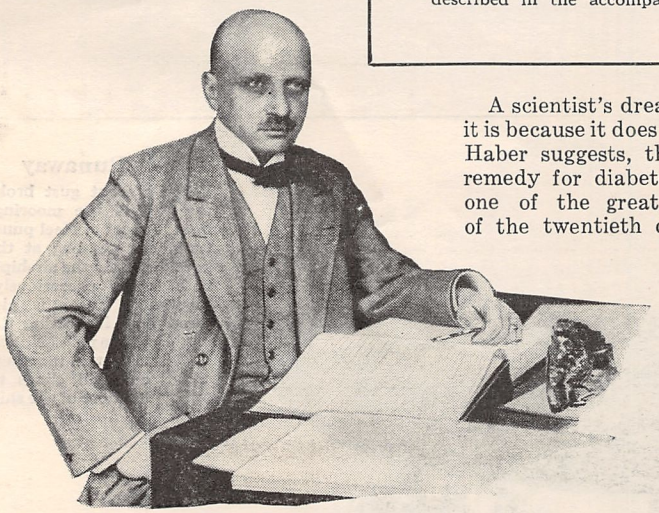
And, thanks to the efforts of science in combatting the ravages of disease, the average span of life is increasing every year.

Are we to expect, then, that in time science will succeed in prolonging the average life until, like Methuselah, we measure our lives by centuries instead of by years.



How Our Life Span Is Increasing

IN THE three-odd centuries since the days of Shakespeare the average span of human life has doubled—from 29 to 58 years. Even in the last century and three-quarters it has increased 20 years. And still it is increasing, through the ceaseless work of science in combatting disease. Noted scientists now believe that men can learn to live a thousand years, and even more. Their reasons for this belief are described in the accompanying article by John E. Lodge



He Sees Fountain of Youth in Chemistry

Professor Fritz Haber, noted German chemist, believes that science, by supplying substances that will prevent important chemical agents of the body from wearing out, can make it possible for us to live 10 centuries or more. It is because of this very property that insulin, the magic new remedy for diabetes, has been proclaimed one of the greatest scientific discoveries of the age in its benefits to the human race

A scientist's dream? Possibly, and yet it is because it does exactly what Professor Haber suggests, that insulin, the magic remedy for diabetes, has been acclaimed one of the great scientific discoveries of the twentieth century.

Eminent scientists have suggested an even more astounding possibility—namely, that science some day may succeed in causing men to live forever!

Professor Fritz Haber, noted German chemist, for example, stated recently his belief that men may learn to live for 10 centuries or more. In the human body, he said, are various essential chemical agents known as "enzymes." These, he said, eventually deteriorate, causing death.

It is more than a theoretical possibility, he says, that science can supply substances that will prevent these important chemical agents from wearing out. Then, he declares, human life can be prolonged as long as the old enzymes are replaced.

Doctor Raymond Pearl, distinguished scientist of Johns Hopkins University, is another who believes old age may be conquered. Old age, according to Doctor Pearl, may be caused by a still undiscovered chemical substance—a poison—that finds its way into the blood and attacks the body cells. Those groups of cells that are weakest, he believes, succumb first, and the particular part of the body that they make up actually dies, while the rest of the body continues to live. What we call death, he believes, does not occur until the various parts of the body have surrendered one by one.

This explanation of the phenomenon of death other scientists have found tenable. Moreover, they have advanced the belief that an "antidote" for the poison of old age some day may be found.

Doctor Alexis Carrell, of the Rockefeller Institute, many times has kept human tissues alive long after the body from which they were taken was laid in the grave. The transplanting of an organ from a dead body to a living one where it has continued to function perfectly, is a feat of surgery performed more or less frequently. Actual death in every portion of the body does not take place, science now believes, until long after the body has reached the grave.

Can science ever replace or repair these dying organs and so prevent death?

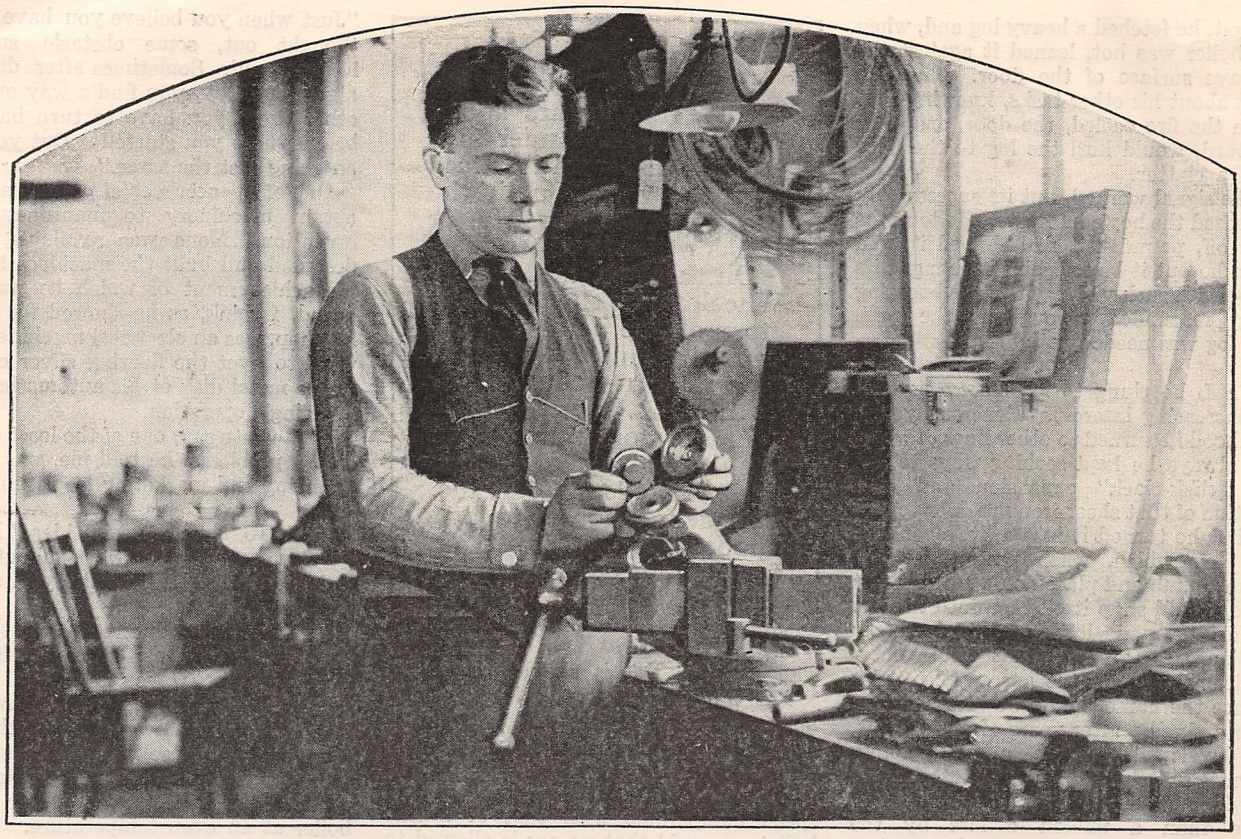
Consider the remarkable things that already have been done with adrenalin, through the use of which faltering hearts have been kept pumping life-giving blood. Consider that not one, but several scientists, have demonstrated in the laboratory that the cells of living things, properly fed, properly warmed, will live practically forever.

Professor Jerry E. Wodsedalek, of the University of Idaho, has demonstrated an ability to control at will the life processes of certain species of insects. Merely through scientific methods of feeding he has caused mature laboratory specimens to live their lives backward again to the hatching stage! Then he has caused them to redevelop to maturity! He has succeeded also in arresting their development at any age he chose, causing them to live without growing older or younger!

ONLY a few weeks ago Prof. C. M. Child, of the University of Chicago, discovered that certain low forms of life, such as flatworms, became physiologically younger under a systematic course of starvation. At the Johns Hopkins Medical School, too, a fountain of youth for frogs was found. Tadpoles were hatched, and kept as tadpoles throughout the length of their lives. Removing certain brain cells, and so preventing the thyroid gland from developing, was the method used in this amazing experiment.

Doctor George W. Crile, professor of surgery at Western Reserve University, is another who has made astonishing revelations. He sees the human body as a great electrical plant. The "vital spark" is an electric spark in fact, he says, that passes through the body over specks of tissue known as "neurones" that make up the nerves. When body parts or functions become defective, the contacts are broken in the bodily electric circuits, and eventually we die.

Various names are used by various scientists in describing processes by which the "vital spark" flames and is extinguished, yet in essentials the theories are amazingly similar—an indication perhaps that science is on the right track in attempting to solve the mysteries of life and death.



John A. Spencer in his machine-shop laboratory at Cambridge, Mass. Here, with his own hands, he designed and built the machinery to manufacture his new million-dollar thermostat. In his right hand may be seen the disk that brought a fortune

He Nursed His Boyhood Idea into a Million-Dollar Invention

A Boiler Door in a Lumber Camp Pointed the Way to Fortune

By Edgar C. Wheeler

BY WATCHING steam lift the lid of a teakettle, the boy James Watt, so the story goes, received an impression of its useful power that led eventually to the development of the steam engine and revolutionized the world's industry.

In like manner, more than a century and a half later, another boy, by watching heat contort the fire door of a steam boiler, found the idea for a remarkable new kind of thermostat which, by providing an effective new means of automatic heat control, engineers say, may revolutionize the manufacture and use of everyday gas, steam, water, and electrical heating equipment.

The second boy is John A. Spencer. At the comparatively youthful age of 33, he not only has seen part of the rights to his invention sold for more than a million dollars, but he has attained the highest goal of every young inventor—a first basic patent granted by the United States Patent Office. And he has done all this with practically no schooling save the hard, practical grind of machine-shop and factory.

In the small laboratory of the Spencer Thermostat Company at Cambridge, Mass., I sought out Spencer the other day to learn the story of his invention. I found him bending over a low table, deeply absorbed in a pile of blueprints. His stocky frame was clad in a rough flannel shirt of grayish brown, plain blue trousers, and heavy broad-toed shoes. His hands bore the marks of years spent in close touch with machinery. He raised himself slowly, almost lazily, from his work.

Almost from babyhood, I learned, he had been thrown on his own resources, for his father had been killed in a Maine lumber mill. At an age when most boys are learning to write, young Spencer turned to the lumber camps and sawmills for a living. There he worked at odd jobs—fetching water, sweeping sawdust, washing dishes, and tending fires. As he worked he found a tremendous interest in mechanical things.

HE WAS only 13 when he started inventing. At the time he was employed in a sawmill at Davison, Me. His job was to keep open the chutes through which waste sawdust from the saws was discharged by poking the waste with a long pole. For a day or so he worked diligently with the pole, and then an idea flashed upon him. Why not design the chutes so they wouldn't jam, and thus save the labor of poking them?

Young Spencer set to work with saw and hammer and when he finished, the chutes had been transformed to a shape that would permit the sawdust to run freely. That was Spencer's first invention! He had invented himself out of a job! This experience, however, did not discourage the boy. He still persisted in seeking shortcuts in his work—new ways of doing old things—a habit that resulted in his million-dollar invention.

IN THE same sawmill he was employed later as a night watchman. One of his jobs was to keep the fire going under a steam boiler, and during his tours of inspection he had to run to the boiler-room constantly to see whether the fire needed replenishing.

A peculiar thing about this boiler that fascinated the youth was a rounded, sheet-iron fire door that had the astonishing habit of literally snapping itself inside out when the heat reached a certain point. The iron that before had bulged outward like a bubble, turned inward like a saucer. Later, when the fire cooled, it snapped back as suddenly to its original form.

This curious action had been observed and had been commented on by other men in the mill. But to Spencer it immediately carried an idea. He would use it as a signal to warn him when the fire needed fueling.

First, he fetched a heavy log and, when the boiler was hot, leaned it against the concave surface of the door. Then he went about his other tasks, knowing that when the fire cooled, the door, snapping outward, would hurl the log to the floor with a clatter.

The signal worked, but its success only increased the boy's interest. He took the door off, pounded it and shaped it, and when he put it back again, it changed its shape with such violence that its booming clang resounded throughout the mill. The log was needed no longer.

STILL he clung to his discovery with increasing interest. Reaching young manhood he turned to other lines of work, but always he kept seeking ways to put the "click-clack" expansion and contraction of that sheet-iron fire door to use.

First he turned it into a little concave disk toy which, when pressed with a warm thumb and placed on a cool floor or table, would snap itself high into the air.

Next he made it into a simple safety appliance for gas jets that would automatically snap off the gas supply, if by chance the flame should be blown out.

And, finally, after years of experiment, he developed it into a quick-acting thermal switch, the United States rights of which have just been purchased for more than a million dollars by the Westinghouse Electric and Manufacturing Company for use in electric irons and other heating appliances.

Marvelously simple is the application of Spencer's invention, first of all, in the electric iron. It is just a little disk made of two thin sheets of different metal (nickel steel and monel) welded together and embedded in the sole plate of the iron. To the convex surface of the disk are riveted three floating knobs of silver, arranged to make contact with six electric switch points in series. While the iron first is getting heated, these contacts engage the switch points, completing the electric circuit and heating the iron. But when the heat reaches the limit of safe and efficient working temperature, click!—the disk suddenly snaps back to concave shape, instantly breaking the contacts and automatically cutting off the electric circuit.

The iron cools, until the temperature reaches the low limit of ironing efficiency. And, click!—the disk flings itself into its previous convex shape, remaking the contacts and heating the iron once more. And so on indefinitely, making and breaking contacts as long as the iron is in use. Thus the housewife is assured that her iron always will remain at just the right heat for use, and that it cannot become dangerously hot.

THE secret of its operation lies in the fact that one of the metals forming the disk expands more readily than the other.

A Small Beginning

EIGHTEEN years ago a boy boiler-tender in a Maine lumber mill noticed that the variation in the heat of his fire played queer tricks with his boiler door.

On these pages Edgar C. Wheeler tells the dramatic story of the development, from that small beginning, of a million-dollar invention.

It is a story that has all the fascinating romance of fiction. It is a story, too, that demonstrates today's opportunity in invention for wide-awake Americans.

The result of this is a sudden warping.

The thing that is revolutionary about Spencer's thermostat is that its action is almost instantaneous. The snapping disk, he told me, clicks the current on or off in less than .00018 of a second—a speed comparable with that of a rifle bullet, so rapid that no arc is allowed to form and corrode the contacts.

If you ever have placed a tin can on a stove and have seen the bottom of it snap out of shape when subjected to heat, you probably will be astonished that an idea apparently so obviously simple should prove so valuable. Yet to perfect this switch to a point of dependable usefulness, Spencer devoted more than eight years of discouraging labor.

"There's a funny thing about trying to invent something," Spencer said, with a wry quirk of his tightly knit mouth. "Just when you believe you have it all thought out, some obstacle suddenly looms ahead. Sometimes after days and nights of study, you find a way out. At other times you have to turn back and begin where you started. But you keep on going just the same."

One of Spencer's chief problems was to obtain machinery to manufacture his invention. None was available, so he designed and built the machines himself. An achievement of which he was most proud, I think, as he showed me around his shop, was an electrical machine he devised to rivet the floating silver contacts to the metal disk of his automatic switch in a single operation.

Strange to say, one of the least difficult of his problems, he told me, was that of financing and marketing his invention.

"IF YOU have a useful idea," he said, "you never need worry about financial backing. There is always a demand for such ideas."

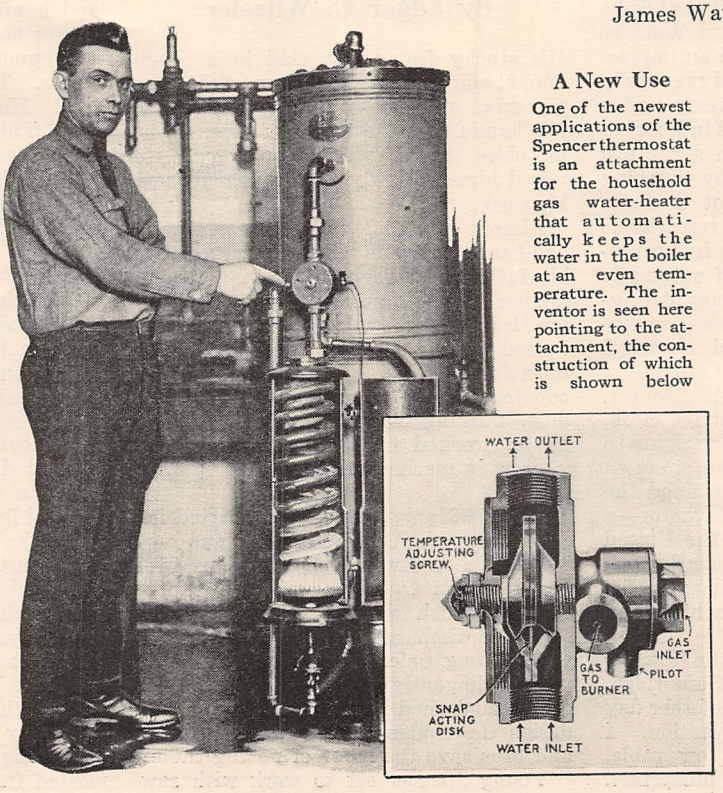
Every day Spencer is on the job among his machines; always he is thinking out new ways to apply his invention. Already he has 35 inventions in the Patent Office. One of the most interesting of these is an attachment for the household gas water-heater that automatically keeps the water in the boiler at an even temperature. In this, the same snapping disk operates a valve that shuts off the gas supply when the water reaches a certain heat, and turns it on again when the water cools. A pilot light ignites the gas when it is turned on.

Other applications crowd upon the inventor in ever-increasing numbers. You can easily guess some of them—self-regulating coffee percolators, cooking pots that won't boil over or burn dry, automobile motors that never overheat—in fact, almost every kind of useful appliance that requires heat regulation.

The whole secret of Spencer's amazing success—the same secret that enabled James Watt to give the steam engine to the world—may be summed up in Spencer's own words:

"You can find something new in everything—if only you will sit down and study it long enough. And when you have found a new idea, you will be amazed at the possibilities it opens up for new and useful application.

"A hundred years ago my invention wouldn't have been worth a nickel," Spencer confessed. "It is only through the development of modern appliances and machines to which automatic heat control can be applied that my idea has any value whatever. Invention invites invention."



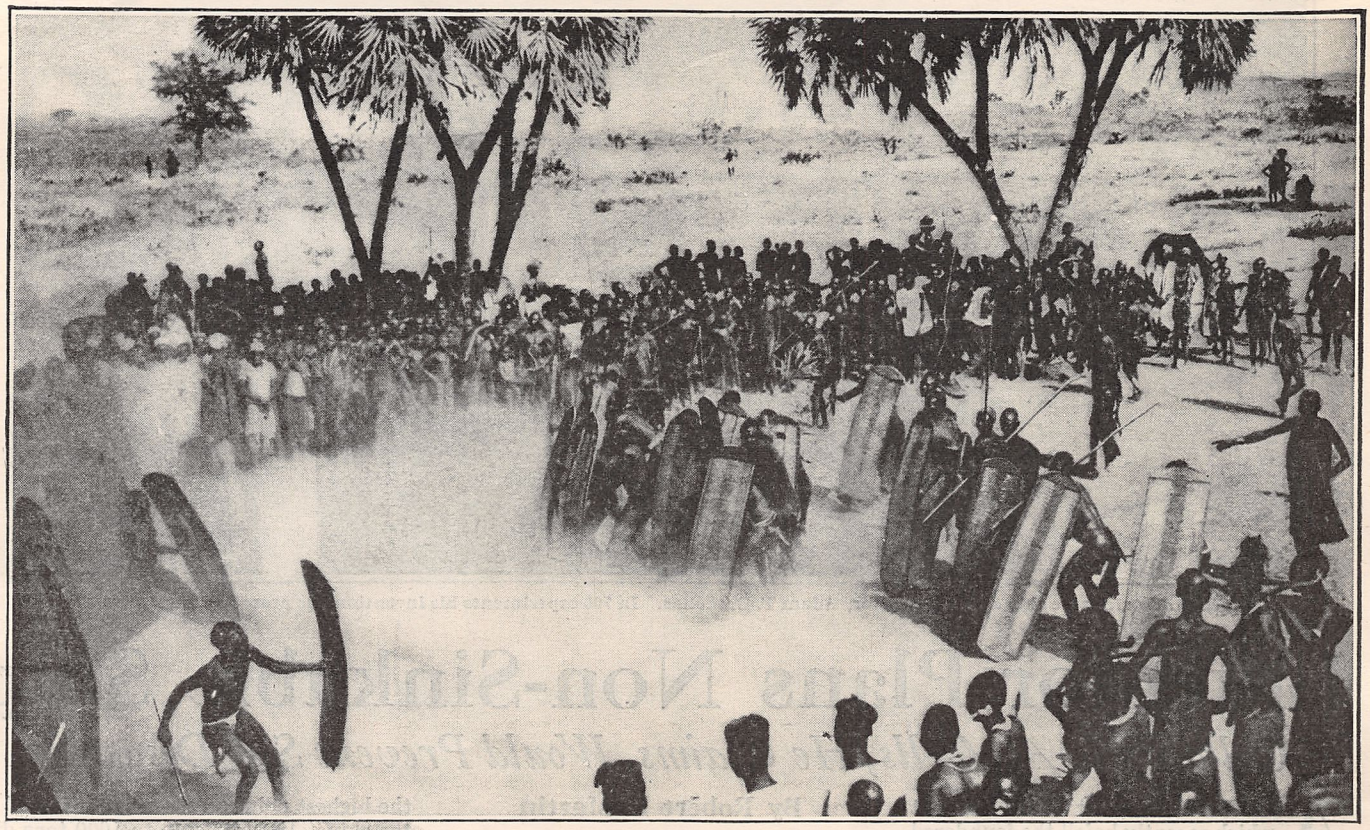
A New Use

One of the newest applications of the Spencer thermostat is an attachment for the household gas water-heater that automatically keeps the water in the boiler at an even temperature. The inventor is seen here pointing to the attachment, the construction of which is shown below

DID you know that in your back yard there are more than a thousand different species of insects? A remarkable article next month will describe some of the marvels of nature to be found at your own doorstep if you look for them.

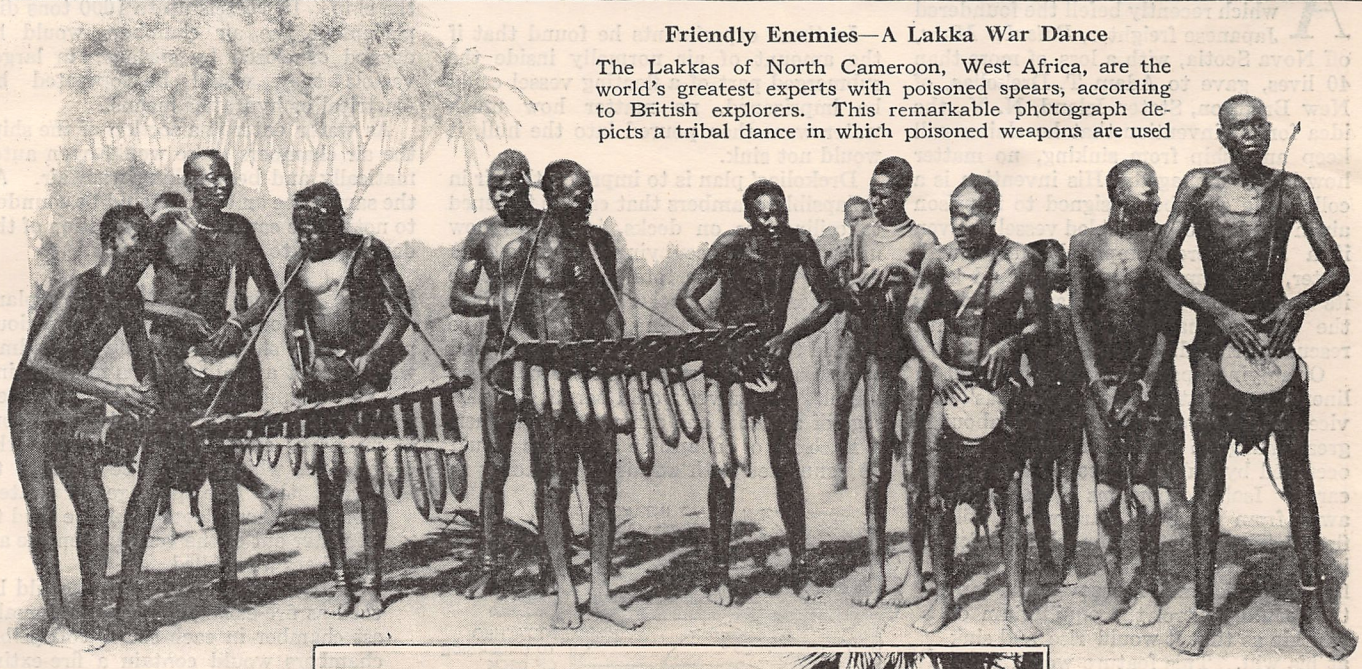
Playing with Death in Africa

Cameroon Natives Use Poisoned Spears in Tribal Dances



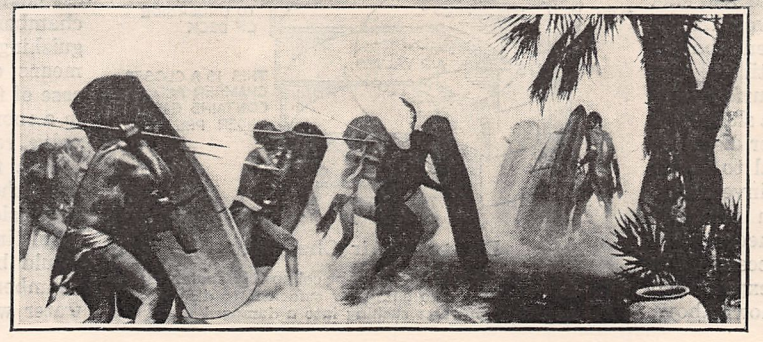
Friendly Enemies—A Lakka War Dance

The Lakkas of North Cameroon, West Africa, are the world's greatest experts with poisoned spears, according to British explorers. This remarkable photograph depicts a tribal dance in which poisoned weapons are used



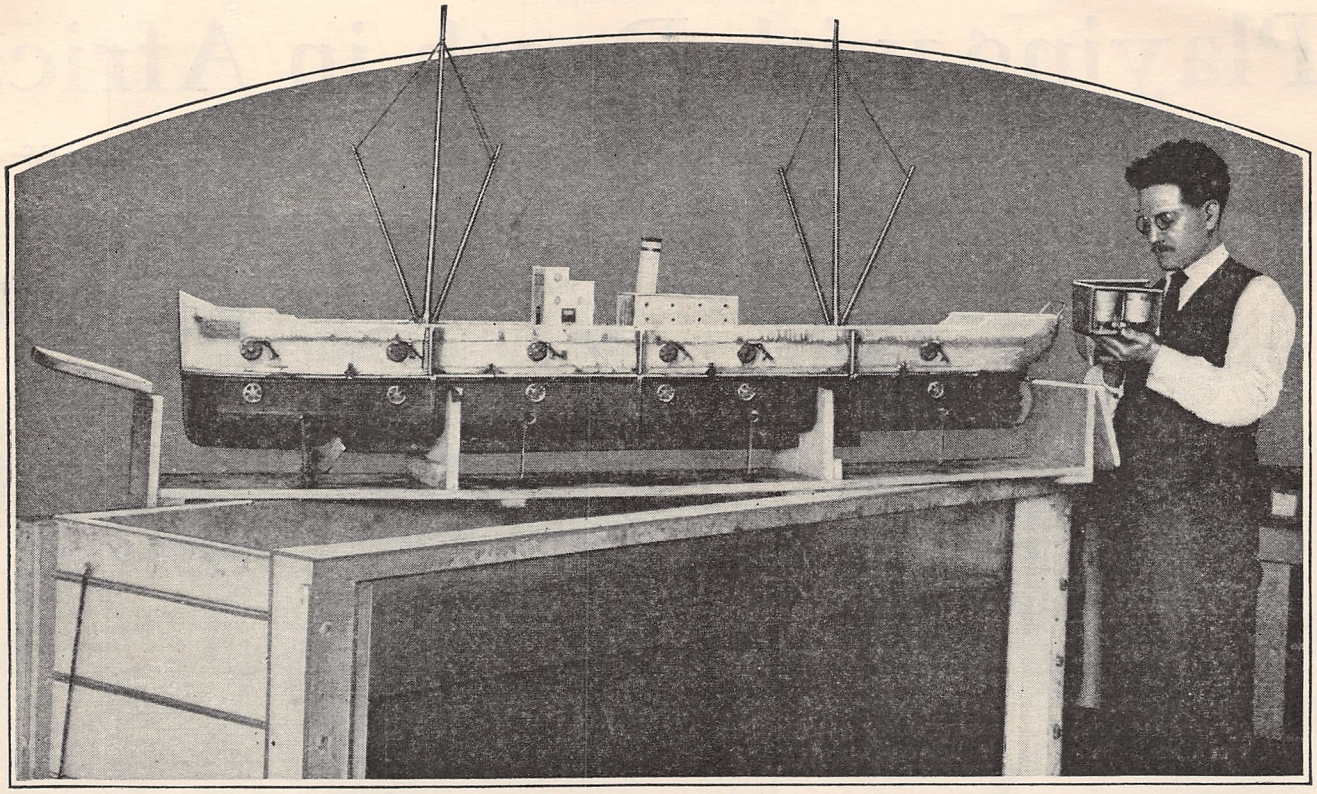
"'At a Boy, Lakka!"

This jazz band is to the Lakka warriors what a cheer squad is to a college team—it urges to greater effort. The long instruments, supported around the neck by a strap, are played like xylophones, the hanging gourds giving resonance to the sounds. The orchestra beats drums and sings weird war songs, with shrieks and wild battle cries



A Mock Attack

How the warriors use the spears and shields in an attack. The shields, man high, are made of woven osiers, sometimes covered with buffalo hide. The Lakkas are uncannily expert at spear throwing and handling the shield so that it covers any part of the body, and many times they have resisted successfully armed invasion



Model of non-sinkable ship and its inventor, Adam T. Drekolias. In 700 experiments his invention has proved successful, he says

Inventor Plans Non-Sinkable Ship

Collapsible Air Cells, He Claims, Would Prevent Sea Disasters

By Robert E. Martin

APPALLING disasters such as that which recently befell the foundered Japanese freighter, *Raisuku Maru*, off Nova Scotia, with a loss of more than 40 lives, gave to Adam T. Drekolias, of New Brighton, Staten Island, N. Y., the idea for an invention that he claims will keep any ship from sinking, no matter how badly damaged. His invention is a collapsible chamber designed to imprison air in the hull of a disabled vessel. Even if a ship were completely filled with water, he claims, the device would keep its upper deck above the surface, giving the crew a chance for their lives until rescuers arrived.

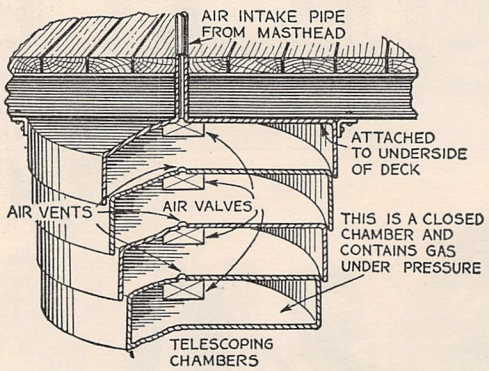
Occupying space ordinarily wasted in liners and battleships, Drekolias' device, he believes, would bring about a great change in shipbuilding. Space now occupied by bulkheads could be used for cargo. Isolated portions of a ship cut away from the main part would still float. The same equipment used for keeping the boat afloat would serve as fire-extinguishers. Moreover, the captain could control the equilibrium of his ship so that it would rise and sink at his will. This feature would be of special value in warfare when a battleship could be lowered until only its guns remained above the surface.

As long as the weight of a ship is less than the weight of the water displaced by the vessel, or just equal to it, the ship will float. Drekolias' invention is based on this well known principle, first pointed out by Archimedes. The apparatus has proved successful, he says, in more than 700 experiments made with the model ship shown above.

In these experiments he found that if the amount of air normally inside the submerged part of a floating vessel could be imprisoned, no matter how much water were then poured into the hull, it would not sink.

Drekolias' plan is to imprison the air in collapsible chambers that can be fastened to ceilings or on decks, in spaces now unutilized and occupying not more than five per cent of the total nonusable space underneath the decks. The chambers would fit one inside another and could be opened to admit the amount of air needed to displace water rushing into a damaged vessel. Air valves would permit the passage of air from one chamber to another.

Each set of collapsible chambers would be connected with an air pipe leading to the highest point on the mast or funnel of the ship. In vessels up to 1000 tons displacement the air chambers would be opened or closed by springs; in larger vessels they would be operated by electrical or hydraulic means.



Design of Air Chambers

Fitting one inside another, the collapsible chambers would be opened to admit air sufficient to displace the weight of water rushing into a damaged vessel

As water entered a section of the ship, the air chambers there would open automatically and begin filling with air. At the same time an alarm would be sounded to notify the captain of the location of the danger and to warn passengers.

THE captain, by Drekolias' plan, could release air chambers in various parts of the ship at will, and also admit water to act as ballast, thus maintaining the ship's equilibrium. A ship equipped with the air chambers would have doors in its sides, either above or below the water line, which could be opened to permit the free passage of water. Normally these doors would be used to let water out of the vessel when the air chambers were filled.

In two ways the chambers could be used as fire-extinguishers. The smallest chamber in each set of collapsible chambers would contain a fire-extinguishing gas, and would be sealed. By means of a thermostatic control, in case of fire, the change in temperature in a room would automatically open a valve, releasing the gas.

If a fire were too large to be extinguished by the gas, the doors in the ship's sides would open automatically, admitting water, while equilibrium would be maintained by opening air chambers in the rooms where the water was admitted.

The Greatest Sport Event in History

Three Nations Racing for the Pole!

Thrilling Aerial Ventures into the Bleak Unknown

By Fitzhugh Green, Lieut.-Comm., U. S. N.

THE most sensational sporting event in human history is being pulled off this summer. Three nations are racing for the North Pole. After months of grooming, a score of daring fliers are now on the starting line at the edge of the ice-floes Official entries have been given out as Roald Amundsen, representing Norway; Grettir Algarsson, England, and Capt. Donald A. MacMillan, the United States. Other nations, too, including France, Germany, and Japan, are reported to have planned polar flights for the future; and because of the tremendous hazards of polar exploration, any one of these, even though not starting until 1927, may have a chance to win.

Culminating four centuries of heroism, an American, Admiral Robert E. Peary, U. S. N., was the first to reach the Pole by sledge. This year's effort will be by air. Where Peary struggled northward in blinding drift and bitter cold, the 1925 explorer will sail gaily outward in calm sunshine of the arctic summer. Where Peary reached the earth's axis with sight of only a narrow thread of ice-pack, MacMillan, Algarsson, and Amundsen will swing and circle over hundreds of thousands of square miles of unexplored area as yet unseen by human eye.

Who will win? Of what nationality will be the eager frost-slashed face that is thrust triumphantly over the cockpit combing of the first Pole plane? Shall we ever know? Or shall we wait as the world waited after the hapless Andree drifted northward from Spitzbergen in 1897 and never was heard of again?

In a sense the answer seems simple. Amundsen should win because he is north first—in fact, by the time this article appears he may have actually hopped off. He is a good arctic traveler, with years of experience behind him, and his base in Spitzbergen is only about 10 hours' flight from the Pole, the goal of the race.

Yes, theoretically, Amundsen should win. Practically, though, there may be a vastly different story told when the race is finally placed in history. For, practically, the Frozen North is a savage beast so far as the flesh and blood of men is concerned.

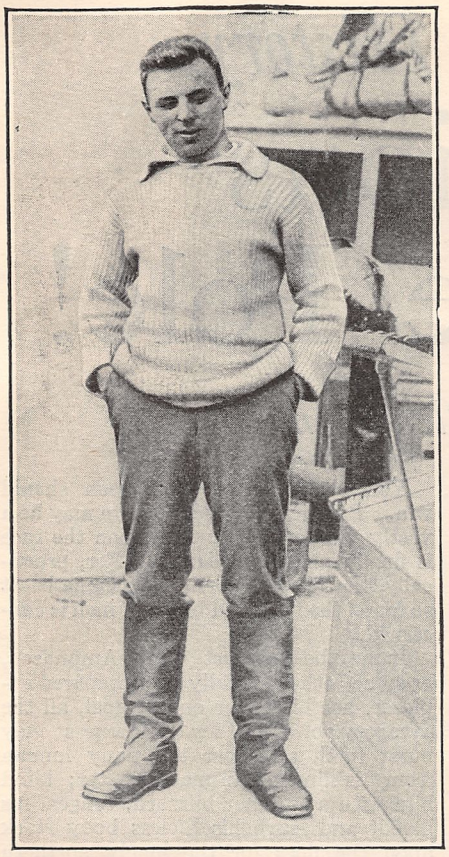
It may be that just when Amundsen, or some other equally well prepared explorer, has his finger on the goal, all the savagery of that icy wilderness may burst forth and tear the puny human from his flimsy man-made shelter; blind him with a summer blizzard, congeal his blood, and leave his lifeless body stark upon the floes for the lonely northern

America's Hope

Here is the daring Yankee leader in the race—Capt. Donald A. MacMillan, a former lieutenant of Admiral Peary. It was during polar explorations with Capt. MacMillan that Commander Green, author of this article, first learned of a supposed vast, uncharted continent in the Arctic

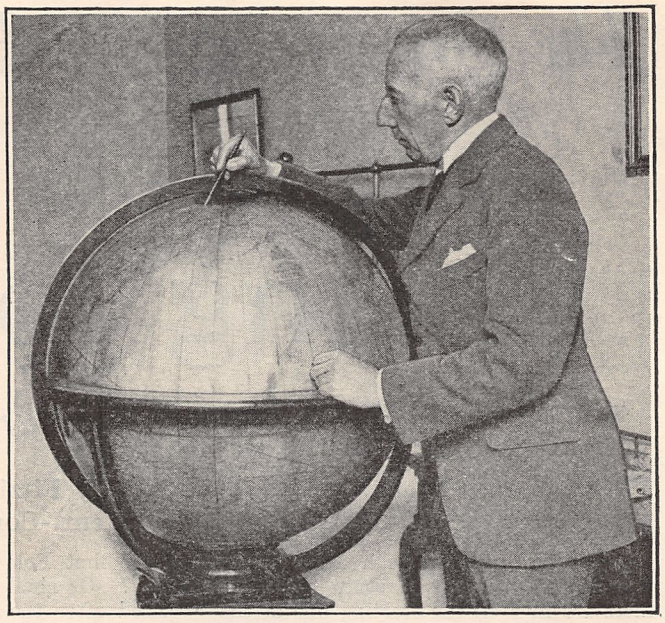
Three Air Paths to the Pole—Who Will Win?

This map of the Top of the World shows the routes chosen by Norway, England, and America for the race. Amundsen for Norway and Algarsson for England both will gamble on a quick 550-mile jump from Spitzbergen. The American MacMillan, with his flying base at Axel Heiberg Land, gains the advantage of being closer to the heart of the vast unexplored polar area which is the real goal of the contestants



Banks on Airship

A young Icelander, Grettir Algarsson (left), is the British leader. His advantage over Amundsen lies in the fact that he has a small dirigible. If he goes adrift or runs out of fuel, he can sit tight and take a chance on drifting to his base



A Gambler's Chance

Roald Amundsen, famous discoverer of the South Pole (right), is taking the greatest gamble of all, for his success is completely tied up with the success of his planes. If they fail, he fails. The picture shows him pointing to the place where he will hop off for the North Pole

raven to gloat over. That is what the North is like.

To us, warm here at home, there is a deal of sporting thrill in contemplating the chances of each contestant. Secretly, maybe, we are glad there are no odds. The man who wins must be courageous and very strong; but he also must have with him the luck of the gods. That's where the big suspense will lie between now and the time we shall learn the fate of the various entrants.

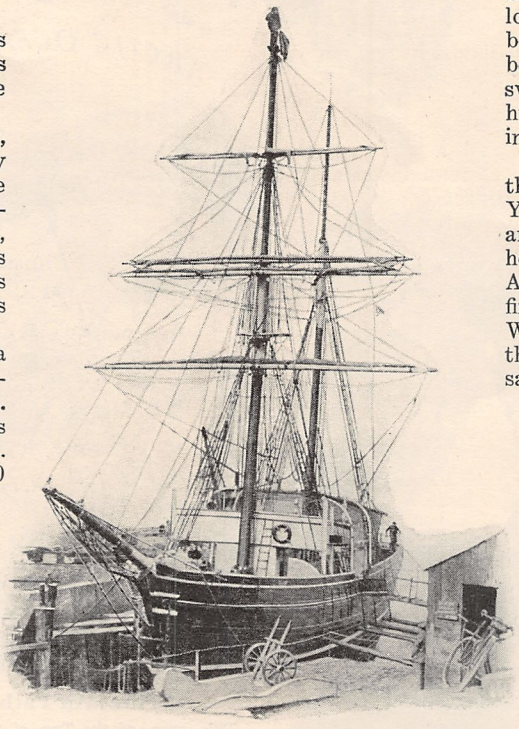
EACH explorer knows the chances he is taking. And each has made his plans to suit his own analysis of the perils.

The British, under a young Icelander, Algarsson, have chosen what Peary termed the "European route" to the North. That is, they will beat up northeastward, past Norway to Spitzbergen, whence only the polar pack separates them from the top of the world. Thus Algarsson will have the same base as Amundsen.

Both these expeditions visualize a "jump to the Pole"; a stunt; a gambler's chance to get there and back alive. The actual distance each has to cover is about 550 miles out and 550 back. Amundsen has estimated the trip at 20 hours. There can be no base on the ice, because the ice is forever moving. Daylight will attend the journey, for the season will be summer. In emergency, retreat afoot will be next to impossible because in summer the floes are covered with deep ponds of water. Game far from land is very scarce. A gambler's chance, and little more if an engine stalls and a wing is smashed on a berg. Yet if all goes well, the flight will be a lovely jaunt in unbroken sunlit calm. Thus Norway and Britain may be looked on as running the race "neck and neck."

America's plans are more ponderous. Donald B. MacMillan, one of Peary's lieutenants, will follow what is known as the "American route," that used by Admiral Peary in all his northern work. To carry North the navy airplanes that will make the polar flight he has chartered the *Thetis*, one of the most famous ships that has taken part in arctic navigation. Originally a Dundee (Scotland) whaler, built a few years before 1884, this historic vessel played a spectacular part in the rescue of seven survivors of the Greely Arctic Expedition.

With MacMillan will be fliers from the United States Navy. Headquarters will be established at Etah, a native village on the northwest corner of Greenland about 700 miles from the Pole. Thence planes will fly northward to the extremity of Axel Heiberg Land, about 530 miles from the Pole, and establish an emergency base of supplies. Subsequent flights will be toward the Pole and over the Polar Sea as weather may permit.



Ready to Battle Polar Ice

In this little ship the British under Algarsson will beat northeastward past Norway to Spitzbergen, whence they will attempt an airship flight to the Pole

MACMILLAN must negotiate the "graveyard" ice of Melville Bay. He will force his two ships through the treacherous growlers off Cape Sabine. Probably he will have to hazard his ships and men before he even lands. If so, he accepts the hazard. He is playing a dangerous game for a great stake; he can afford to take chances.

He will not drop his anchor off odoriferous Etah until well along in August. The fiord there will have been blown free of floes by the cutting winds that race at breakneck speed down off the ice-cap. Smith Sound Eskimos will help him unload fragile wings and fuselage. Windbreaks, repair sheds, fuel tanks, all must be erected. There must be haste. The swinging sun dips now below the northern hills. Perceptibly the days are shortening.

His radio men will be hurrying with their receivers. Not that news is vital. Yet news *will* be vital. For MacMillan and his men will be wondering in their hearts whether they are too late: whether Amundsen or Algarsson have got there first and shamed our Yankee effort. Well may this be the case. It is part of the chance MacMillan takes when he sails from the home port.

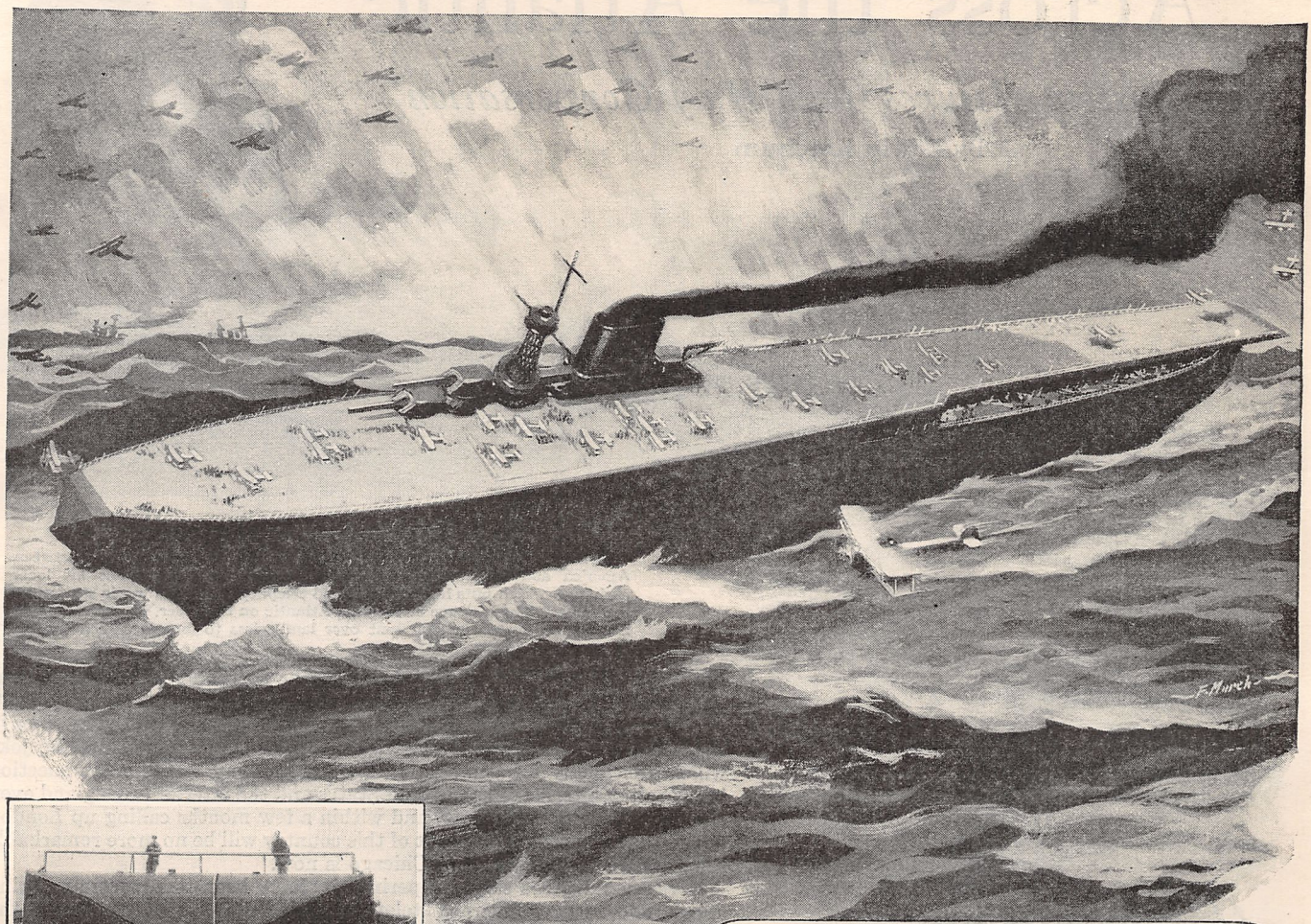
The American effort is worth studying more in detail. There is more *finesse* to it. The complexity of its plans for basing north and westward piques one's interest. And it is in the very complexity and multifarious details of the American's preparations that his greatest hope of success lies.

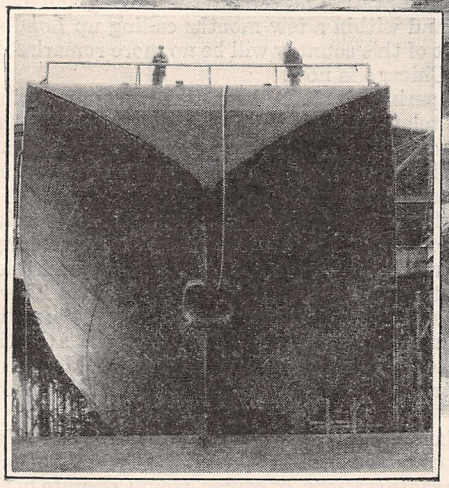
How elaborate these preparations are may be realized from the fact that Uncle Sam's two great dirigibles, the *Los Angeles* and the *Shenandoah*, will be held in readiness at Lakehurst, N. J., to speed northward in response to any call of distress that may be radioed by the

(Continued on page 112)

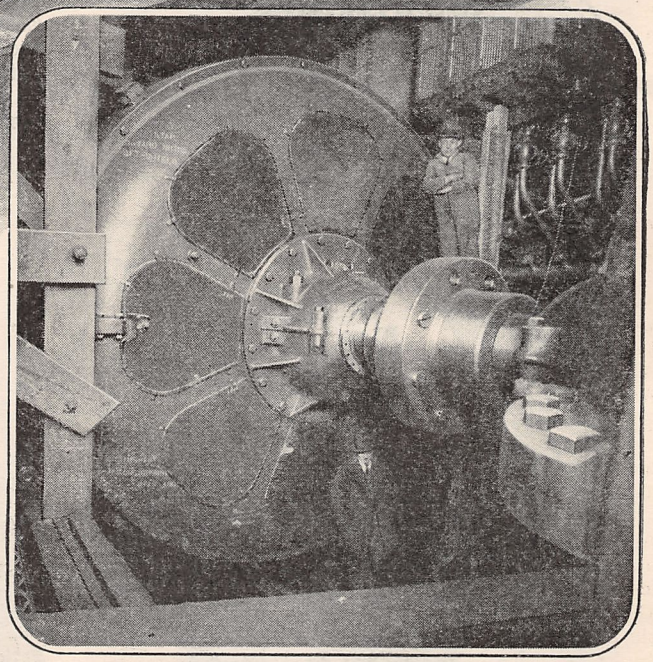
Our Navy's Deadly Nest of Wasps

The "Saratoga"—World's Mightiest Airplane Carrier





At the left is a view of the *Saratoga's* bow. Notice how the great flying-deck terminates in a lap that curves downward to facilitate the landing of planes



At the right is one of the eight immense electric motors, each capable of developing 22,500 horsepower. They will send the 33,000-ton vessel through the water at the speed of 39 miles an hour

WHEN the world's greatest airplane carrier, the *Saratoga*, slid down the ways at Camden, N. J., a few weeks ago, Secretary of the Navy Wilbur characterized her as "designed to take her deadly brood of wasps far ahead of the fleet, within scouting range of the enemy, or where her bomb-carriers can attempt to destroy enemy battle fleets."

Such is the vivid picture of Uncle Sam's mighty mother ship that our artist has portrayed here. Carrying a buzzing swarm of 72 fighting planes—32 bombers and 40 combat machines—she will represent, when completed, the last word in naval construction.

Not only is the *Saratoga* the world's largest carrier, but she is the longest naval craft afloat (her length is 888 feet) and she is driven by the most powerful engines ever put into a vessel. The immense sweep of her vast flying-deck is broken only by a massive combination funnel inclosure, set off at the side of the hull.

Eight electric motors driven by current supplied by four immense steam turbines, and capable of developing 180,000 horsepower, will drive her through the water at a speed of 39 miles an hour. She is speedier than any battleship afloat, and only modern cruisers and destroyers can keep pace with her. Although practically unarmored, her potential destructive force is greater than the guns of the greatest dreadnaught. Her sister ship, the *Lexington*, will be launched next fall.

Now You Can Talk Across the Atlantic

New System Assures Two-Way Conversation

By Edwin Ketchum

How Messages Travel across the Atlantic

The black arrows indicate the course of two-way conversations between America and England. An American calling London signals his local exchange, which puts his call over land telephone lines to a radio station on the coast. The message crosses the Atlantic on the ether, is received at an English coast station, and sent over land wires to the person being called

IF, SOME day in the next half-year or so, you lift your telephone receiver from the hook and hear the operator say, "Just a moment, please—London wants you," don't laugh and hang up the receiver in the belief that some one is playing a joke on you. If you do, the joke will be decidedly on yourself, for direct two-way telephone connection between the interior of the United States and the interior of England even now is an accomplished fact, and within a few months calling up London or the Continent from any part of this country will be no more remarkable than calling New York from Chicago is now.

For several years secret experiments have been in progress to bring about two-way commercial telephone service between this and the Eastern Hemisphere. The experiments have been successful, and facilities soon will be available for the inland telephone subscriber on either side of the Atlantic to make transoceanic calls.

Both radio and wire telephony are employed. A man in Georgia, say, desiring to call London, would merely signal his local exchange operator. The operator would put through the call over land telephone lines to a radio transmitting station on the coast. There connection would be made between the telephone line and the radio transmitter, and the message would be carried over the Atlantic on the ether. On the English coast a radio station would receive the message, and transmit it over telephone lines to the person called.

Since England is connected with the Continent by telephone, calls could be made to Paris or other European cities. The radio stations, of course, would operate both transmitting and receiving apparatus for transatlantic calls, so that two-way communication would be established as over an ordinary telephone line. Transatlantic telephone conversations have been successfully carried on by this method at various times within the last few weeks, according to advices from England.

The American Telephone & Telegraph Company has had telephone service of a sort to Great Britain for the last two years. That is, messages could be sent to England by radio then delivered by telephone to any part of Great Britain. England, however, had no apparatus for sending messages to us. Now, though, the British Post Office is building a high-power radio station at Rugby, which, with the Radio Corporation's station at Rocky Point, make transatlantic telephone service a convenience that will be available to all of us soon.

Masterpieces of Cavemen Found

A Caveman Artist's Gigantic Cavern Studio

The marvelous Round Room of the Niaux caves in France, showing silhouettes of bisons drawn on the walls

Daring Explorer Discovers Amazing Ancient Drawings

By Arthur A. Stuart

LYING flat on a raft, a French archeologist named Mandement, recently pulled himself through a passageway in one of the inky caverns of Niaux, near Tarascon-sur-Ariège, and discovered some of the most remarkable examples of prehistoric art ever found. Drawings of animals, etched in the walls of the cave by unknown artists of the Stone Age, show a primitive skill that has excited keen interest among the archeologists of the world.

The grottos of Niaux in the far south of France near the Spanish border have been known for centuries by the neighboring peasants, but avoided with superstitious awe. A large lake covers part of the floor of the fore part of the grotto. Earlier investigators had stopped their explorations when they came against a barrier formed by overhanging walls, which prevented passage of a rowboat.

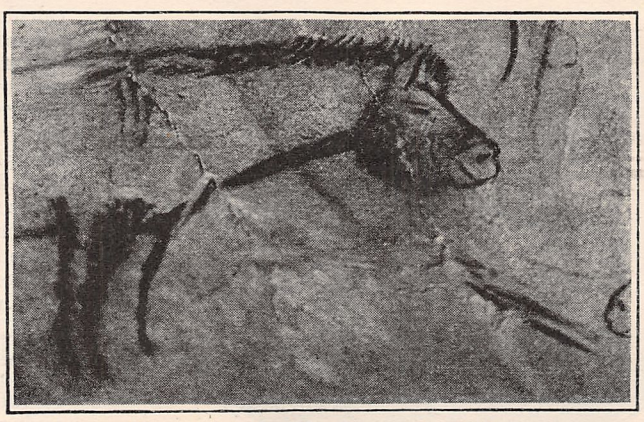
Mandement, determined to see what was beyond, constructed a raft, and on this managed to slip through the crack. It took considerable courage. At any moment he might slip over a precipice into oblivion.

But, passing the barrier, he found himself in a long tunnel. Emerging from this he entered a cave of glistening beauty. Walls rose to a height of 65 feet. Stalactites and stalagmites joined to form long slender columns, suggesting the name, "The Hall of Marble." On the walls were the remarkable drawings.

Venturing into the Unknown

Here is M. Mandement on the raft he used in exploring the Niaux caves. In places the roof came so near the water that he was compelled to lie flat on his back as he propelled himself along

The most notable of these is one of a horse. With firm, sure line the artist, with his crude implement of stone or bone, drew a reproduction, fiery and spirited, showing excellent mastery of proportions. It is a drawing, experts declare, that would be a credit to an artist with centuries of civilization behind him.



Horse Sketched by Stone Age Artist

This is the most remarkable of the discoveries. Drawn with a crude implement of stone or bone, it shows excellent proportions

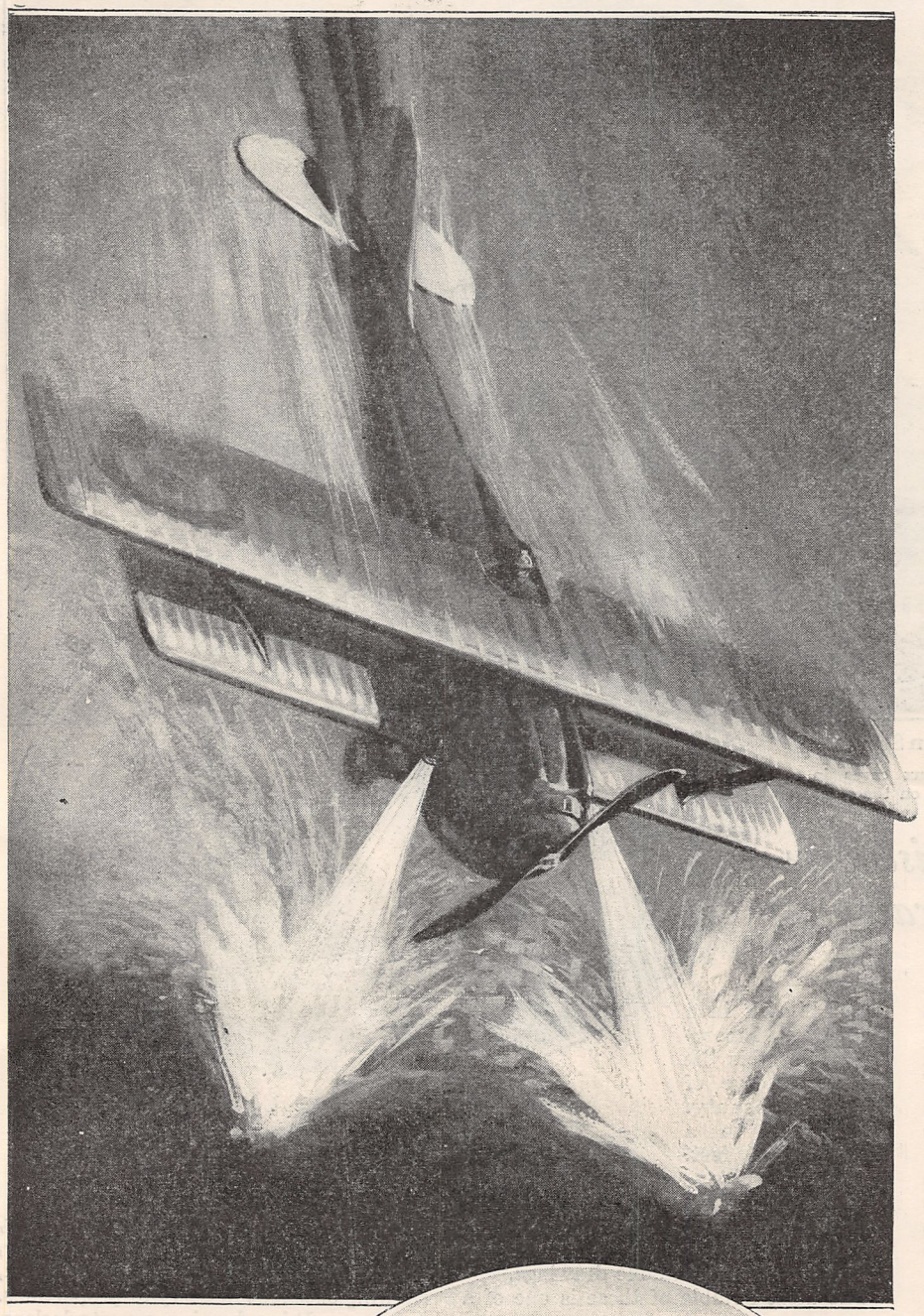
In another cave, which Mandement named the "Round Room," are giant figures of bisons or aurochs. These are done in black, with red stains to indicate wounds inflicted in the hunt. These, too, show amazing accuracy in drawing.

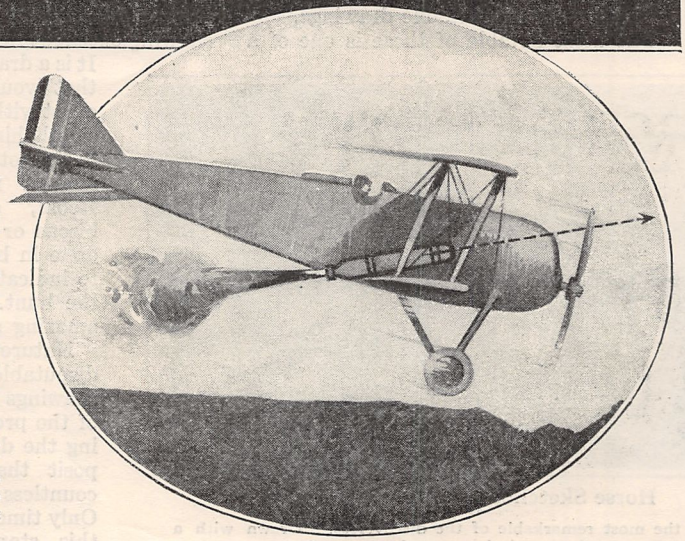
Nature has provided indisputable proof that the Niaux drawings were done by savages of the prehistoric era. Covering the drawings is a lime deposit that must have been countless centuries in forming. Only time could have produced this stamp of authenticity.

New Pilotless Planes

Amazing Terrors of the Air Developed in France—Rockets to Prevent Crashes

By Ellsworth Bennett





Saved from a Fatal Crash

How the amazing safety bombs invented by Capt. Albert Lepinte might save an aviator plunging to earth in a perilous nose dive is pictured above. A series of explosions at the nose of the plane, discharging gas at high pressure would check the speed of descent and stabilize the plane. Similarly, a landing plane would be aided in clearing obstacles by the discharge of bombs beneath the plane, as illustrated at the right

ADVANCES in aviation science almost invariably are along spectacular lines, yet it is unlikely that in many years have there been more amazing developments than in the last few weeks.

As a single instance there is a remarkable invention of Captain Albert Lepinte of the French Army. The general use of this, according to the inventor, would cut in half the number of fatal accidents in flying.

Captain Lepinte's device is a bomb, or rocket, designed to counteract the phenomenon that aviators call "loss of speed," which is responsible for possibly 50 per cent of the deaths of flyers.

Airplanes are constructed to fly normally at an angle of about nine degrees from the horizontal. If this angle is increased slightly for some reason, the plane immediately begins to sink, due to loss of speed and decreased "lift." If this happens while the plane is high in the air, the aviator can return to normal position by operating his elevator. If the loss of speed occurs near the earth, however, the pilot cannot stabilize his plane in time to prevent a bad landing, or possibly a fatal crash. He is obliged to land.

CAPTAIN LEPINTE'S invention is designed to permit pilots, in case of loss of speed, to straighten out their planes, clear obstacles, such as hillocks or depressions at the point selected for a landing, and regain the power of flight. In case of free falling from great heights, the device is intended to check the speed of descent, and stabilize the plane.

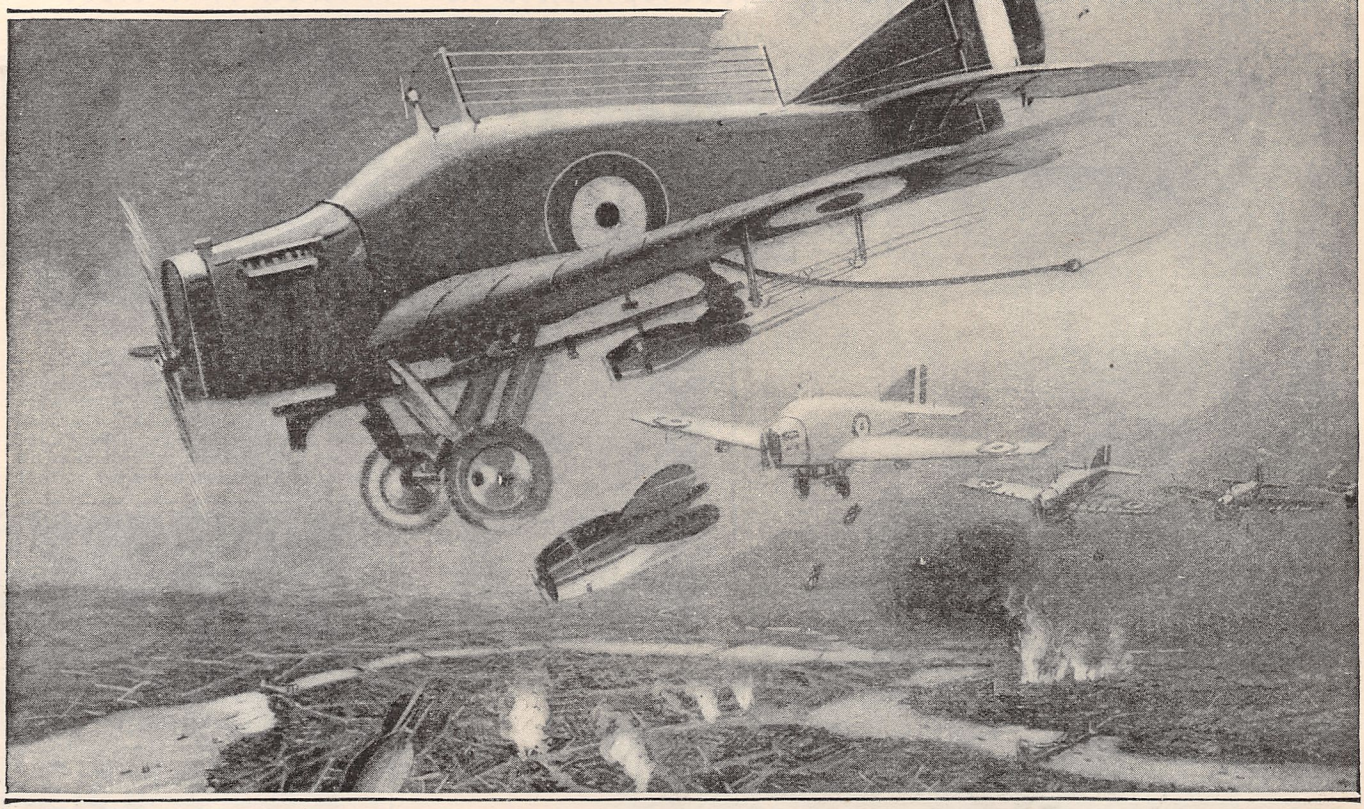
He has placed a series of rockets on the sides of the plane or within the fuselage, set at angles determined by scientific calculation. These are filled with a high explosive, capable of producing a great volume of gas under extremely high pressure. The rockets are set off by an electric spark, and the gas escapes through tubes placed at various parts of the plane. When the rockets are exploded, the volume of gas released produces a retarding or accelerating force on the plane, according to the part of the plane to which it is applied, and this suffices to move the plane into stability.

Thus, the rush of gas through escape pipes beneath the plane will cause it to rise slightly, the inventor claims.

The principle by which the rockets operate best may be explained possibly by saying that the action of the rockets on the plane is similar to the recoil of a gun.

Captain Lepinte's device has been

Fly by Radio



submitted to the technical section of military aeronautics in France and is being considered for adoption by the army.

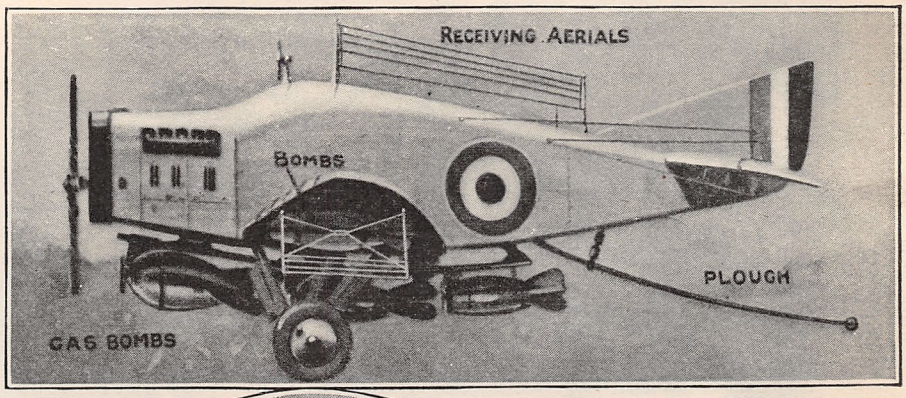
Even more startling is a plane which, advices from abroad assert, is being developed for military purposes in France. This is a radio-controlled bombing airplane, which, when completed, may be the most terrible engine of war ever devised.

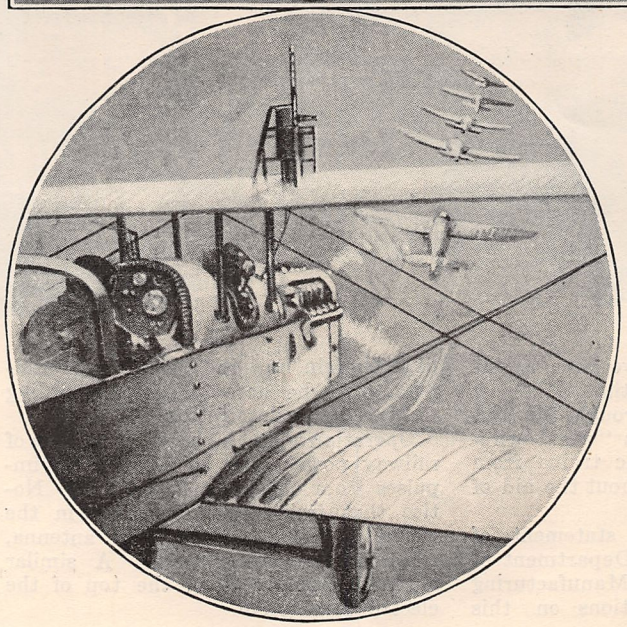
A MODEL of the invention is said to have made a number of amazing test flights. In these the plane was controlled entirely by a "pilot" at a radio transmitting set on the ground. The plane took the air, completed a number of complicated evolutions, and returned to its starting place, entirely obedient to the signaled directions.

Not only that, but, in response to radio impulses, it dropped the tiny bombs it carried and destroyed a miniature city that had been erected for the test.

Another aerial war weapon on which the same group of inventors is working is a torpedo plane, which is said to send forth tiny airplanes filled with explosives. These little planes are to be controlled by radio from the mother plane. They can be directed to any desired spot, then caused to drop and explode.

Brigadier-General Mitchell, of the U. S. Army Air Service, recently asserted in effect that the cities of the world would be helpless under attack from the air. The development of aerial terrors of the kind described above tends to support his opinion, as well as the frequently expressed prediction of military experts that the next war will be fought in the air.



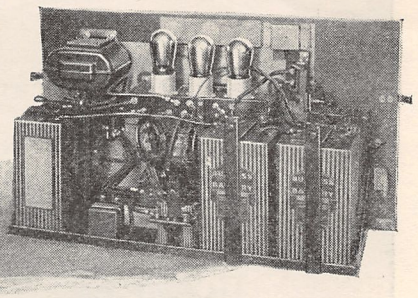


Pilotless Bombers to Hurl Death

The newest terror of aerial combat is the pilotless bombing plane controlled by radio, pictured in the two illustrations above. This machine is driven by electric motors. By means of wireless and ingenious mechanical devices, its course can be directed, it is said, as accurately as if a pilot were in charge. A plow or brake at the rear is designed to halt the plane in making a landing. Another new aerial weapon is the torpedo plane (at the left) designed to send forth flying torpedoes that are controlled by radio in flight

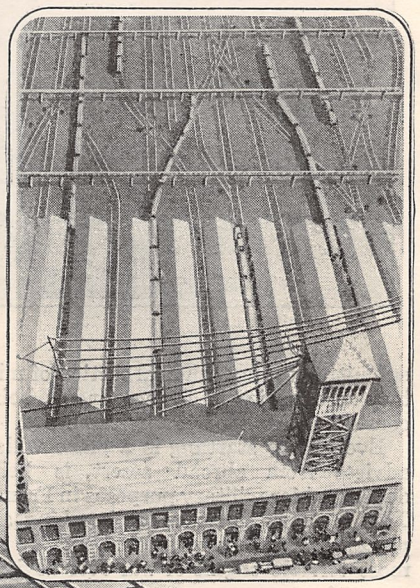
How Radio May Run Our Trains

Expert Reveals Amazing Developments in "Wired Wireless"



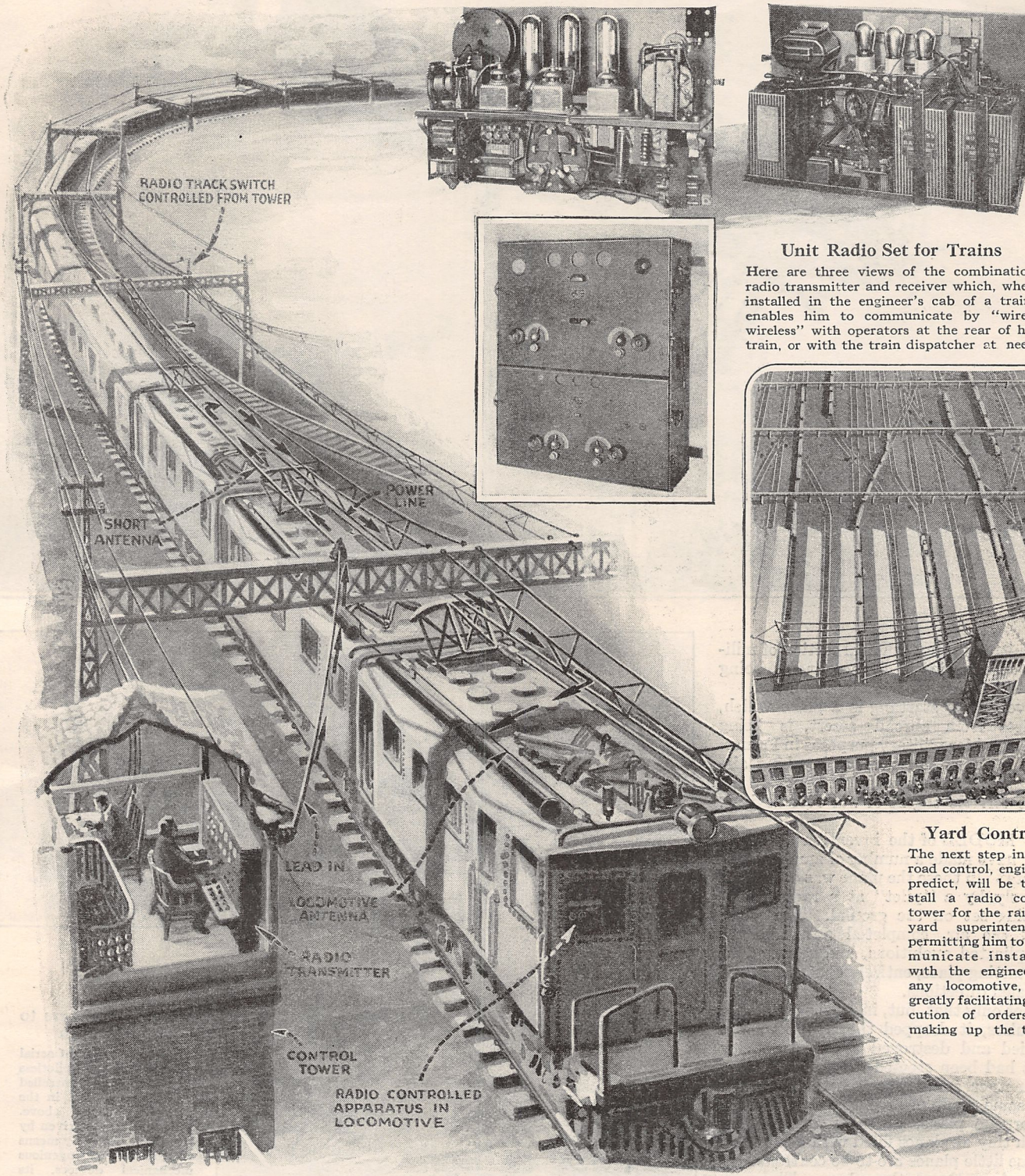
Unit Radio Set for Trains

Here are three views of the combination radio transmitter and receiver which, when installed in the engineer's cab of a train, enables him to communicate by "wired wireless" with operators at the rear of his train, or with the train dispatcher at need



Yard Control

The next step in railroad control, engineers predict, will be to install a radio control tower for the railroad yard superintendent, permitting him to communicate instantly with the engineer in any locomotive, and greatly facilitating execution of orders for making up the trains



SO MARVELOUS have been recent radio developments that it is now entirely possible, through the system commonly known as "wired wireless," to operate electric trains from central control towers without the aid of crews.

Such was the recent statement of G. Y. Allen of the Radio Department of Westinghouse Electric and Manufacturing Company. The illustrations on this page explain how radio control of railroads can be accomplished, according to Mr. Allen's description.

Operation would be based on the use of railway power lines to carry radio impulses from one point to another. Notice that from the transmitter in the control tower extends a short antenna, close to the power wires. A similar antenna extends along the top of the electric locomotive.

Radio waves transmitted from the tower jump across to the power wires, travel along them, are picked up by the locomotive antenna, as indicated by the arrows, and used for operation of radio-controlled apparatus.

Even now a similar carrier current system is being employed by the Pennsylvania Railroad for communication between engineers of long freight trains and the men in the caboose.

HEROES *of* SCIENCE

The Dramatic Stories of Crusaders Who Endure Agonizing Suffering and Even Offer Their Lives to Protect Humanity

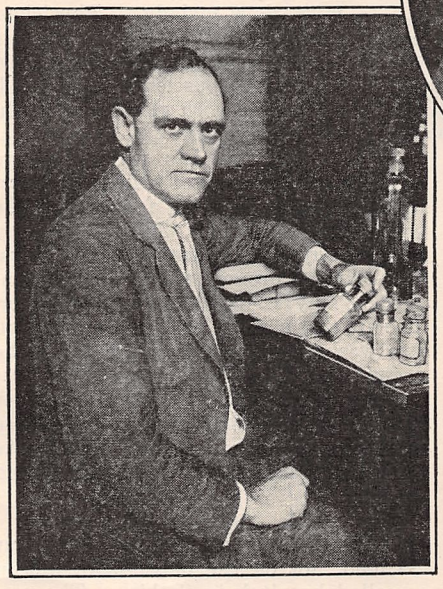
By G. B. Seybold

"THREE or four more days and I'll be delivered."

Professor Emile Bergonie, a French pioneer in radium research, was dying. For nearly two months he lingered, each day adding more atrocious pain. Partly numbed with opiates, he called medical workers to him daily, gave them conclusions drawn from his sufferings, and suggestions of how to go on with radium research. He even planned in minute detail an autopsy to be performed on his body after death.

Working for many years with X-rays in the treatment of cancer, the deadly weapon had turned upon him and burns led to his contracting cancer himself.

Three years before his death his right arm was amputated. He continued his work. Then three fingers of his left hand were removed.



He Discovered the Hookworm Cure

Doctor Maurice C. Hall, of the U. S. Department of Agriculture, was looking for a cure for hookworm. He discovered that carbon tetrachloride cured the disease in dogs, but was uncertain what effect the chemical would have on human beings. By taking a dose himself, he discovered that it was harmless. The great success of the remedy was sensational

Behind him lay a record of distinction. For two inventions alone he could claim the gratitude of humanity—an electric vibrator used in the treatment of shell-shocked patients and a magnet for withdrawing bullets and fragments of steel from wounds.

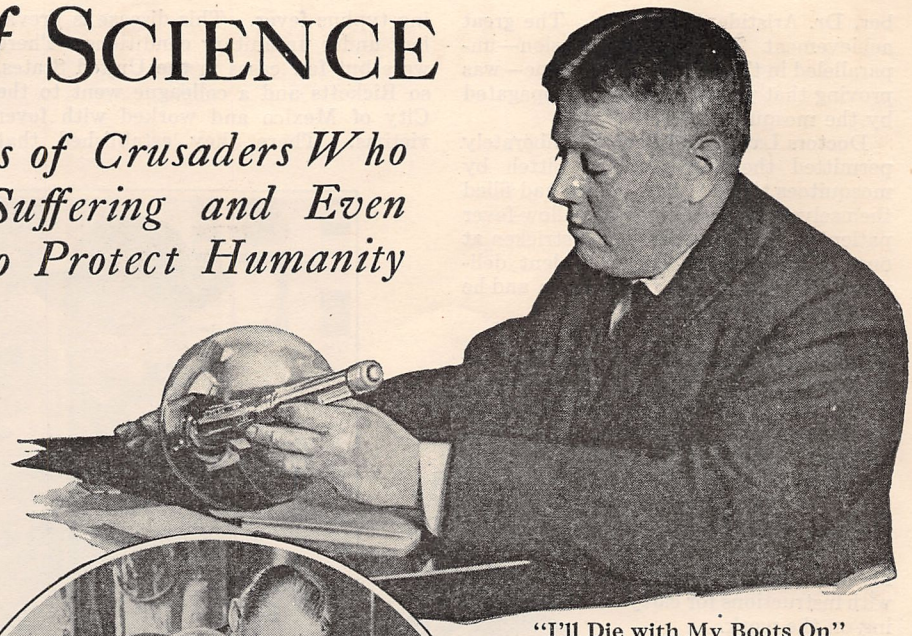
But the eradication of cancer, he felt, was his life work, and only death should stop him. Racked with pain, he fought for three long years. As he lay on his deathbed, France pinned upon him the Grand Cross of the Legion of Honor. He died, known and acclaimed as one of her greatest heroes.

X-Ray Takes Both His Arms

Doctor Charles Vaillant, of La Réboisière Hospital, Paris, had both arms amputated because of infection through X-ray research. His heroism was recently recognized publicly when France conferred on him the Cravat of the Legion of Honor, and Paris the Gold Medal, both rare decorations, and the United States by its ambassador, Myron T. Herrick, awarded him the Carnegie Gold Medal for Heroism

Another brave and famous Frenchman, Dr. Charles Vaillant, of La Réboisière Hospital, Paris, recently was the center of poignant ceremony at the Hotel de Ville. France conferred on him the Cravat of the Legion of Honor; Paris, his own city, the Gold Medal, both extremely rare honors, and Ambassador Herrick, for the United States, presented the Carnegie Medal for Heroism. With both arms gone, sacrificed in X-ray research, this very real hero stood erect and undaunted by misfortune before the assembly that had gathered to do him honor.

AT JOHNS HOPKINS Hospital in Baltimore the other day Dr. Frederick Henry Baetjer underwent his seventy-first operation. The ordeal left him with only two fingers on his hands. One by one, the other eight had gone as a result of ulcers developed from X-ray burns. He lost an eye from the same cause. After the operation, the brave man said: "I suppose my researches will eventually kill me, but I'll die with my boots on."



"I'll Die with My Boots On"

That is what Dr. Frederick Henry Baetjer, of Johns Hopkins Hospital, Baltimore, Md., said after his seventy-first operation, which left him with but one eye, and only one thumb and one finger on his hands. The rest he has sacrificed in experiments with X-rays

The hope that has come to thousands suffering from cancer through results of experiments with radium has meant the sacrifice of nearly 150 scientists; more than a score in the present century. Behind practically every important medical discovery there is a list of crusaders who risked all, even their lives, to establish its truth.

Doctor Maurice C. Hall, of the U. S. Department of Agriculture, was trying to find a remedy for hookworm disease. Working with animals, he found after long experiment that carbon tetrachloride, a substance chemically similar to chloroform and used commonly as a remover of spots and stains from clothing, removed all traces of hookworm in dogs. He tried it on rabbits, but the rabbits died.

What effect would it have on human beings? The only way to find out was through experiment. He measured out three cubic centimeters of the chemical that might mean instant death. He swallowed it. Through his heroism Doctor Hall discovered a remedy for a disease that had been the scourge of the East for centuries.

ONE of the most thrilling examples of scientific heroism ever shown was that of a band of men who risked their lives to conquer yellow fever. This terrible disease used to ravage America year after year, taking thousands of victims. In a single epidemic Philadelphia lost one-tenth of its entire population. At the close of the Spanish War, while American troops were still garrisoned at Havana, the dreaded plague appeared there.

The United States Government appointed a Yellow Fever Commission, formed of Doctors Walter Reed, James Carroll, Jesse Lazear, and a Cuban mem-

ber, Dr. Aristide Agramante. The great achievement of this commission—unparalleled in the history of medicine—was proving that yellow fever was propagated by the mosquito.

Doctors Lazear and Carroll deliberately permitted themselves to be bitten by mosquitoes that 12 days before had filled themselves with the blood of yellow-fever patients. Doctor Carroll was stricken at once. For days he lay in violent delirium. Doctor Lazear treated him and he finally recovered.

DOCTOR LAZEAR was not affected, but some time later, while working in a yellow-fever ward, he was bitten again by a mosquito. He saw it light upon him, and convinced that it was a carrier of the fever, permitted it to bite. This time he acquired the disease in its most terrible form. Before he died he handed his notes over to Doctor Carroll with instructions for carrying on the work.

To test the spread of the disease, a completely mosquito-proof building was divided into two compartments by a wire screen. Infected mosquitoes were put on one side. John J. Moran, a private, volunteered to enter the side containing mosquitoes. He was bitten and came down with the disease. Two susceptible men on the other side of the screen remained in the house 13 nights, almost within arm's reach of the sick man, without contracting the disease.

AGAIN, Robert P. Cooke and two men from the Medical Corps slept 20 nights in stifling heat, surrounded by clothing and bedding of men who had died of yellow fever. None got a symptom of the disease. Afterward, to prove that they were not immune, they exposed themselves to mosquito bites and were infected.

At last it had been proved that the mosquito alone was the cause of yellow fever! Yellow fever as a nation-wide plague was conquered!

Hidden in reports of State Boards of Health, may be found many chapters of heroism. One of these, that of the Montana board for last year, records the death of four men who were investigating Rocky Mountain spotted fever. This fever was widely spread over nine states, with mortality in some places as high as 75 per cent. Doctor Howard Taylor Ricketts believed that the fever was conveyed by the bite of a tick from an infected animal. Dr. T. B. McClintock, Dr. Arthur McCray, W. E. Gettinger, and Henry Cowan all contracted the disease while working with it and died.

Doctor Ricketts' theory was proved. He, fortunately, escaped with his health unimpaired. Next he began investigating typhus fever. This disease is prevalent under unsanitary conditions. There were but few cases in the United States, so Ricketts and a colleague went to the City of Mexico and worked with fever victims. There they established that typhus is communicated by the body louse. For this information, which meant the saving of thousands of lives, Ricketts gave his own life.

Martyr in Radium Research

Professor Emile Bergonie gave his life for science. For years he made a study of radium as a cure for cancer, and even up to his death, daily consulted with colleagues on the action of radium on the body from his own experiences. He lost one arm and three fingers and, finally, his life

From Light to Darkness

As director of Yerkes Observatory in Wisconsin, Dr. Edwin Brant Frost has for years used his eyes in the most delicate astronomical work, and at last is paying toll for his devotion. The sight of one eye is gone, and the other eye is almost covered by a cataract. Nevertheless, this brave scientist, with the help of others, pursues his studies and writings

In Yerkes Observatory in Wisconsin, a sacrifice has been made of which few know. There, the director, the distinguished Prof. Edwin Brant Frost, has literally given his eyesight to the stars. For many years his eyes have been ailing from delicate work with telescopes and microscopes. But he would not give up his work. One night the retina of the left eye was torn loose and the most skilled oculists in the world have given up hope of ever restoring sight to it. A cataract grew over the other eye until it covered it almost completely.

A CRATE arrived in Washington, D.C., one day last year, filled with danger. It contained a live rabbit afflicted with tularemia, a disease that human beings contract from handling rabbits infected with it. In the Western states this disease menaced both hunters and those who bought dressed rabbits in markets. The organism causes a disease the symptoms of which in human beings are similar to that of typhoid fever.

The Government Public Health Service undertook to find out more about the disease in order to protect the public against it. The doctor who began the investigation soon contracted the disease and was replaced by another. Five times this was repeated. The startling rapidity with which the experiments claimed victims, instead of discouraging those in the research, inspired their zeal and the work still goes on.

THE World War added scores of names to the long list of lives sacrificed to science in the present century. One of these was Col. E. F. Harrison, who risked death by poisoning time after time to learn how the Allied troops might be equipped to withstand the German gases. Eventually his lungs became so impregnated with poison that when influenza seized him, he had no resistance and died.

Shortly before the Armistice, a new explosive, tetranitroline, more deadly than TNT, was being developed for the army in a government chemical laboratory in New Jersey. The workmen manufacturing it were overcome with a mysterious malady. Physicians declared that poison in the gas passing through the skin destroyed the red corpuscles in the blood. Protection with gloves and clothing was useless.

Four chemists volunteered to make a series of tests. The first collapsed after working four days. He was a decided blond. The second, who was slightly darker, lasted seven days. The third, a pronounced brunette, managed to stay 12 days before keeling over. The fourth, a swarthy Oriental, worked two weeks, suffering much less from the chemicals.

They had proved by risking their lives that the gas could be made safely by those with heavily pigmented skin. Two weeks later the plant was manned by colored workers.

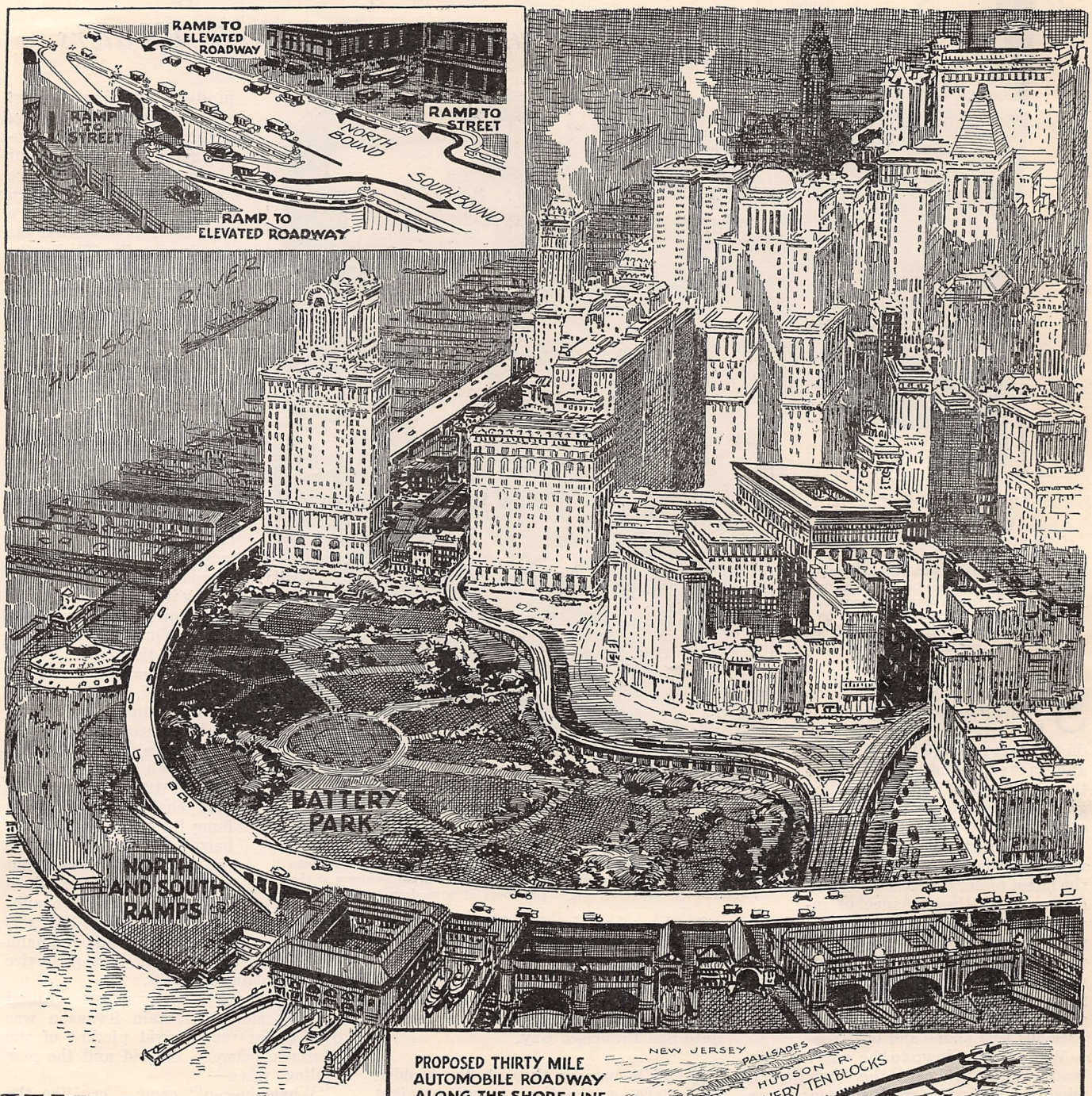
TWO of the great heroes of the war died, not on the battle-field, but in so-called hospitals in Serbia. The epidemic of typhus that occurred in Serbia in 1915 was one of the most severe the modern world has known.

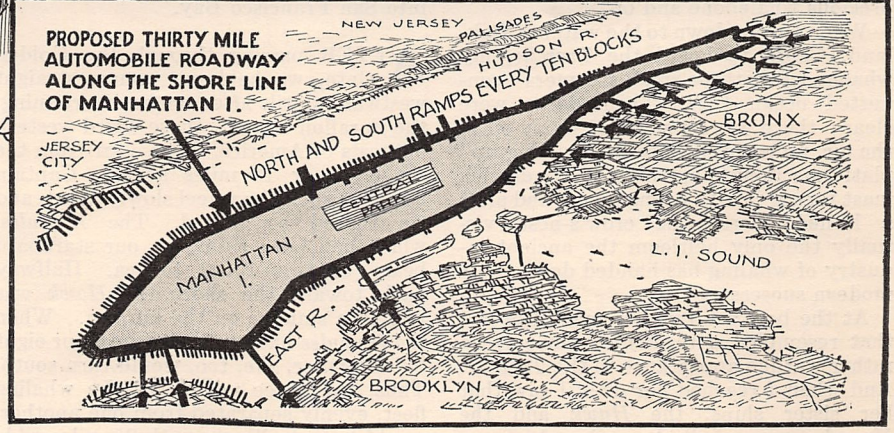
Doctor F. Donnelly, of the American Red Cross, was at the head of a hospital at Ghevgheli. This was an old tobacco factory in a barren, uncultivated country, into which 1400 persons were crowded. The water was infected, what clothes the patients had were swarming with vermin, the dead lay unburied. Working day and night under these appalling conditions, Doctor Donnelly's health finally gave way and he died. Doctor Ernest P. Magruder, in another hospital, worn out by overwork, also succumbed. Three other physicians gave their lives in Serbia.

The list still grows. In hundreds of laboratories and hospitals men are working today to prove facts about disease, facts that eventually will mean larger protection for you and me.

Plans Auto Bridge around New York

A Noted Architect's Vast Scheme for Traffic Relief



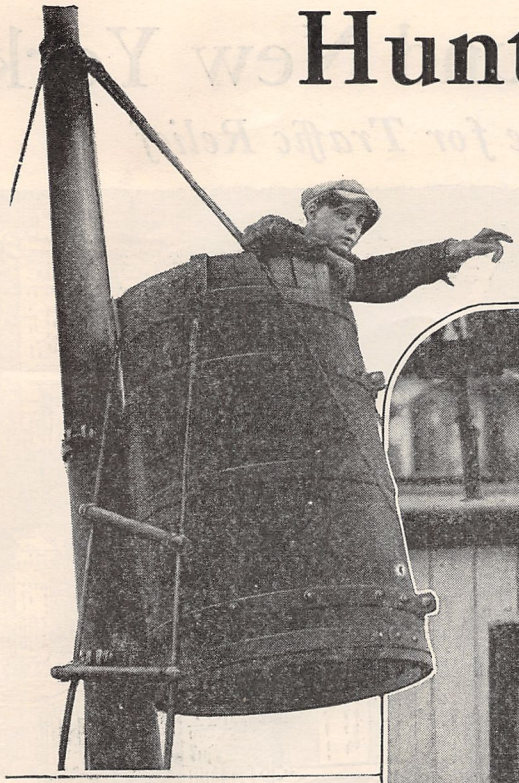


WITH New York City approaching the saturation point in motor traffic within the next five years, D. Everett Waid, president of the American Institute of Architects, recently proposed the startling plan pictured here—a 30-mile elevated automobile highway skirting the entire shore of Manhattan, the island metropolis. Such an unobstructed roadway, free from crossings and with approach ramps at every 10 blocks, would, he believes, have tremendous capacity for passenger cars traveling safely at 30-mile speed. A similar plan also might be applied to any other great American city.

This map shows how the proposed automobile roadway would circle Manhattan, providing access from the suburbs to any point in the city. The proposed system of approach ramps leading from the streets to the elevated roadway is shown in the upper inset.

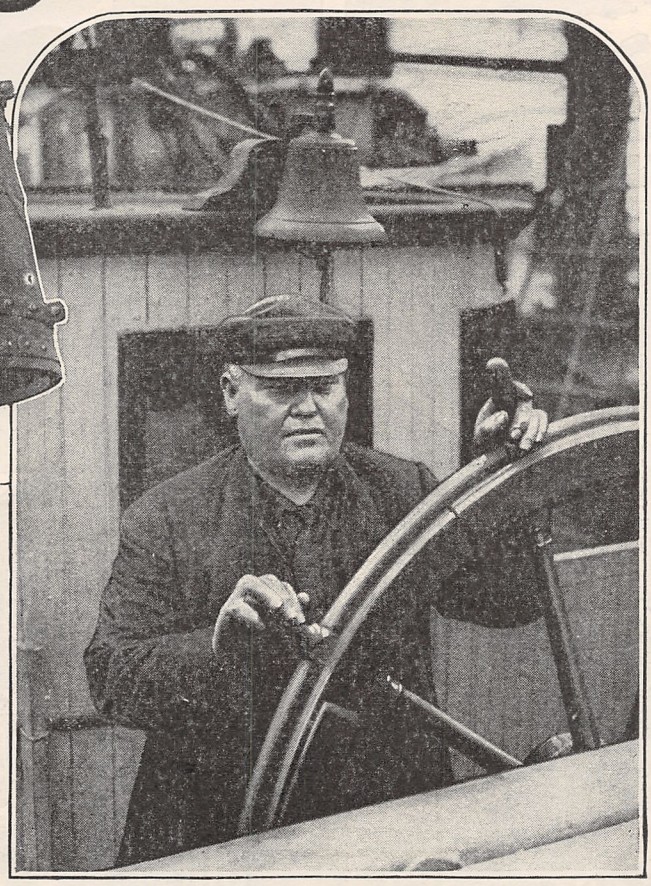
Hunting *Whales* with

How Bustling Little Tugs Have Brought Riches to 1925 Whalers



"Whale ho-o-o!"

A barrel lashed to the single bow mast of the modern whaler is the crow's-nest, from which the lookout scans the horizon in search of whales, and shouts a signal to the skipper below when one is sighted. Here is Barney Cappelin, 17 years old, in his lookout station on the *Traveler*, a modern whaling vessel of the west coast of the United States



Maneuvering His Ship

When the time comes to harpoon a whale, the skipper spins his big wheel, and the little vessel, with the ease of a gun-carriage, turns sharply around to bring the harpoon gun mounted at the bow into direct line with the quarry. Here is shown Captain Swanson at the wheel of the *Traveler*, one of the boats of a modern whaling fleet

SCIENCE has invaded the whaling industry, just as it has invaded every other industry that endures from the past, and its magic hand has brought to this thrilling and romantic calling greater size and prosperity than ever before.

I have just returned from a voyage aboard a modern whaler—the latest of her type. A new kind of romance—the romance of inventive skill, I found—has replaced totally the haphazard, dangerous, and dramatic methods of the hardy Yankee seamen who used to sail from New Bedford, Mass., in their sailing ships to roam the seven seas—sometimes for years—in quest of precious whalebone and oil.

When I went down to the water at Oakland, Calif., to board the *Traveler*, my whaler, I saw three small steamers—converted ocean tugs. Their decks were clean; there was no smell of whale oil in the air, no patched sails, no "cutting up" platforms alongside; only a heavy derrick mast forward, with a long boom, and aloft a lashed barrel—the crow's-nest—virtually the only heirloom the ancient industry of whaling has handed down to its modern successor.

At the bow a tarpaulin-covered object that resembled a three-inch gun gave a rather warlike appearance to the *Traveler*. And when I reached her deck I saw that her sister ships, the *Hawk* and the *Hercules*, were similarly equipped.

Fuss and ceremony have no place on these modern whalers. A few moments after I reached the *Traveler's* deck, Captain Swanson, looking little like the traditional skipper of a whaler, appeared at the huge wheel. There were a few curt orders; hawsers were cast off, and the three vessels moved down the estuary into San Francisco Bay.

AFTER passing through the Golden Gate, we held our course straight westward until, after an hour's running, the Farallon Islands, those weird western outposts of America, lifted clear from the sea eight or 10 miles ahead. Captain Swanson spun the wheel slowly aport, and we turned southward. The *Hercules*, which had been riding on our starboard beam, continued out to sea. Halfway back toward the shore the *Hawk* was merely a smudge on the horizon. When the *Hercules* had proceeded seven or eight miles farther, she, too, would turn south. Thus, the three vessels of the whaling fleet, evenly separated from one another, would be patrolling a path 25 miles wide down the coast.

And there is the general scheme of modern whaling—short voyages, two or three days at the most, by swift steamboats that go scarcely out of sight of land. Once we were settled on our southern course, Barney Cappelin, a boy of 17, mounted the crow's-nest, Gus Thelin, the gunner, removed the tarpaulin from the device I had noticed at the bow, and the skipper rang for half-speed ahead.

An hour only from shore, and we were hunting whales already!

THELIN revealed a short gun of about three-inch caliber, not unlike a trench mortar, except that its "elevation" was down rather than up. It was mounted on a turntable standard, so that it could be swung in any direction, and raised or lowered with one hand. Out of the muzzle projected the head of a huge steel harpoon, with barbs 15 inches long. There was a cap in the head, and in this Thelin placed a charge of high explosive.

Meanwhile one of the crew of 12 hooked the 30-foot chain "leader" that hung from the head of the harpoon to an "eye" at the end of a two-inch cable that ran to an automatic winch below-decks. Another sailor tried the pressure in an air hose that was connected with the hollow shaft of a hand harpoon. The use of this strange device I shall explain presently.

For perhaps an hour we cruised leisurely along. Captain Swanson was drawing for me a vivid picture of the difference between the old and the new whaling, when—

"Whale ho-o-o!" came a cry like the scream of a gull in the sky.

It was young Cappelin in his crow's-nest. Of course, I rushed to the rail and eagerly scanned the horizon. My excitement, however, was shared by no one else on board.

The skipper gave not so much as a glance aloft.

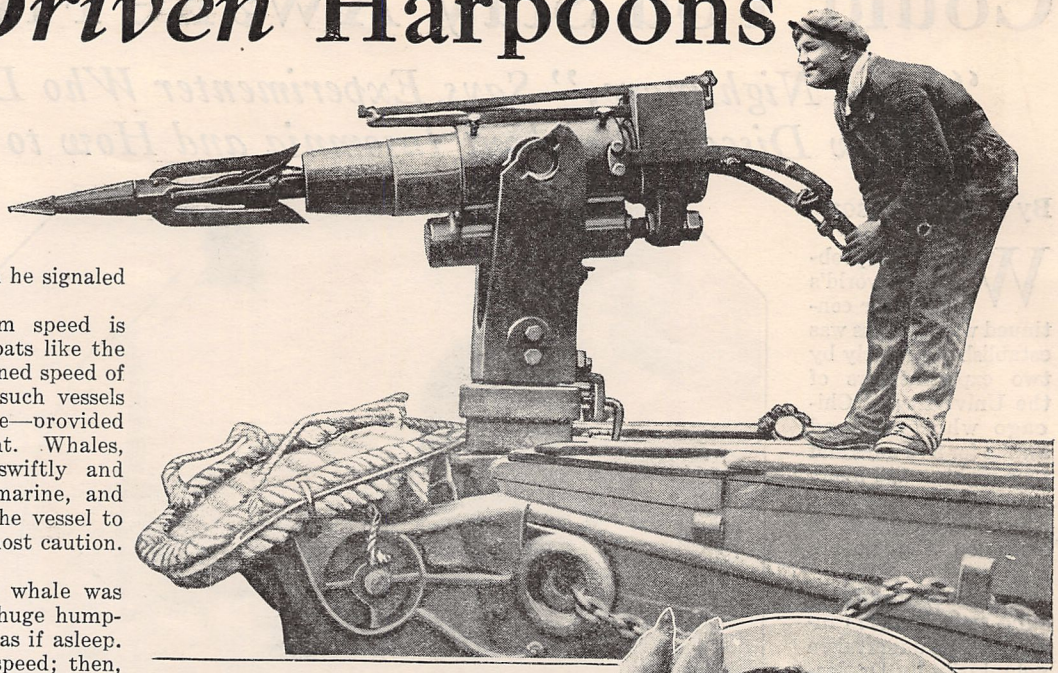
"Where away?" he called back to the lookout.

"Dead ahead for one; hard aport for two," replied the latter, meaning one whale lay directly in our course, another to our left.

The captain sent another man aloft with instructions to watch the whale at the left—the smaller of the two, the

Gun-Driven Harpoons

By
H. H. Dunn



Ready for Action

The modern whaler's harpoon weighs 150 pounds and is shot out of a three-inch gun in the bow of the boat. The head contains a charge of high explosive, which goes off in the whale's body and kills it. The harpoon is attached by cable to a power winch by which the whale is drawn up to the vessel. Here's Gunner Thelin of the *Traveler* about to fire at a whale

lookout had reported. Then he signaled for more speed.

Now, a whale's maximum speed is about 15 knots. Whaling boats like the *Traveler* are capable of sustained speed of 17 or 18 knots an hour, so such vessels always can overtake the whale—provided the latter can be kept in sight. Whales, though, dive much more swiftly and expertly than the best submarine, and this makes it necessary for the vessel to approach its quarry with utmost caution.

IN FIFTEEN minutes the whale was visible from the deck—a huge humpback, floating on the surface as if asleep. The captain signaled for half speed; then, as we approached, quarter speed. I was trembling oddly as we crept, far too slowly, it seemed to me, toward that great floating mass. The crew, too, seemed now to feel the excitement of the chase. Without commands they were moving to their stations, each man tense and eager.

Now the whale was 300 yards away—200—only 100 now—then 75. Almost imperceptibly Captain Swanson swung his wheel, bringing the bow dead on the whale, and—boom. Thelin, the gunner, had pressed the trigger.

An infinitesimal fraction of a second later there was a soft thud as the harpoon went home. The whale threw its flukes into the air. Then came another dull booming sound as the explosive charge in the harpoon went off. The whale's huge tail dropped to the sea with a tremendous splash; the great mammal turned halfway over, rolled back again then lay quivering, dying, on the gray-green water.

Somebody shouted a command. There came the sound of moving machinery from below-decks as the winch began to turn, and the cable that had followed the harpoon across the water was drawn taut,

Out of the Mouth of a Whale

More than 10,000 household brooms and brushes are made from the mouth of a single whale. This picture shows the "finners" split to a workable size and bundled for easy handling by the workers at the broom factory

and the whale—60 feet long, and 60 tons, about, in weight—was hauled slowly to the starboard side of the *Traveler*.

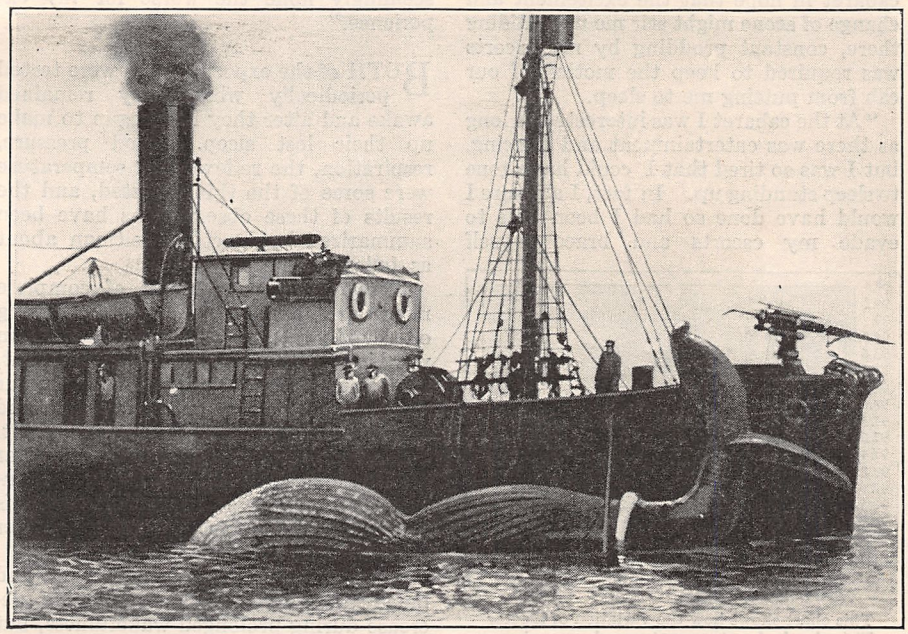
There the carcass was lashed, and a man with a hand harpoon leaped on the dead monster and drove the weapon into its belly.

"Give him the gas!" he shouted, and there was a hiss as the sailor at the air pump obeyed.

ALMOST immediately the huge body swelled up like a great, grotesque balloon. To me that was one of the most amazing features of the modern, scientific method of whaling—that the carcasses of whales, instead of being cut up on the spot, as in the picturesque old days of the sailing ships, are inflated and left floating to be picked up later, while the whaler steams forth in the search of more game.

When the proper degree of inflation had been attained, the harpoon was withdrawn and a 20-foot pole with a red flag at the top driven into the body. Then the whale was cut loose, and the *Traveler* swung about and off for the second whale.

(*Continued on page* 116)



How the Prize Is Inflated and Cast Adrift

In the old days of whaling, the whale was cut up at the place of capture, the whalebone and oil removed, and the carcass thrown away. Now, a hollow-shafted harpoon is thrust into the dead whale and an air pump blows up the carcass, which is marked with a flag and cut loose, to be picked up later by the whaler and towed to shore at the end of the voyage. This picture shows a captured whale's body inflated like a balloon, ready to be cut loose from the *Traveler*

Could You Stay Awake Five Days?

"It's a Nightmare," Says Experimenter Who Did It—His New Discoveries about Insomnia and How to Avoid It

By Hyatt Gibson

WHAT is probably a world's record for continued wakefulness was established recently by two experimenters of the University of Chicago who remained awake for five days and four nights—115 hours—in order to study the effects of long lack of sleep on the human body.

This unique and grueling experiment in insomnia was undertaken voluntarily by Dr. Nathaniel Kleitman and Dr. N. F. Fisher. They went through their trying experience at different times, observing each other in turn. Two assistants attended the subjects of the test to keep them awake.

The story of his unusual experience as told by Doctor Fisher supplies a thrilling recital.

"The first day was, of course, easy," he told me. "I did my laboratory work as usual, and I also spent most of the first night at work. Any one can stay awake for a single night, and most persons probably have done so.

"On the second day I was only slightly tired. I worked about as usual, except for a slight feeling of weariness. Staying awake on the second night, though, was most difficult, especially between two and four in the morning, when all was still. After dawn, and on the following day, when there was something to hold my interest, the task was easier. On the second night, however, great mental effort was required to keep awake, and my attendant had to shake me repeatedly.

"CONTINUAL effort was necessary to keep awake on the third night. If my attendant had left me for even a minute, I am sure I should have dropped asleep. And, though I knew his presence was necessary, it irritated me greatly. I wanted to strike the attendant when he shook me, and only his prolonged and heated protestations prevented me from thrashing him for doing what I had asked him to! Such are the vagaries of a mind depressed and wearied by lack of sleep.

"I had quite lost interest in my laboratory work. Writing, which had become very difficult after the second day, was now practically an impossibility.

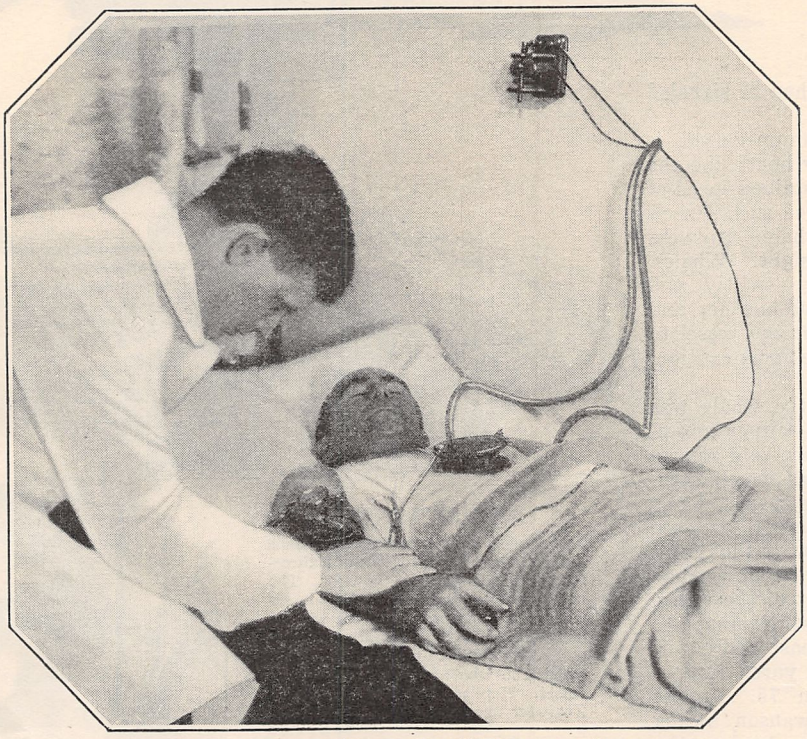
"The fourth night found me terribly depressed. I did not want to work at all. All I wanted to do was sleep. To make the task of staying awake a little easier for me, my attendants took me to a cabaret in hope that the excitement and change of scene might stir me up. Riding there, constant prodding by my escorts was required to keep the motion of our cab from putting me to sleep.

"At the cabaret I was interested as long as there was entertainment and dancing, but I was so tired that I could have gone to sleep standing up. In fact, I am sure I would have done so had I been able to evade my escorts and brace myself against a wall or post.

"About this time I was suffering intensely from an acute burning sensation in the eyes. My appetite was voracious, for the energy I was expending in keeping myself awake I could supply only through food.

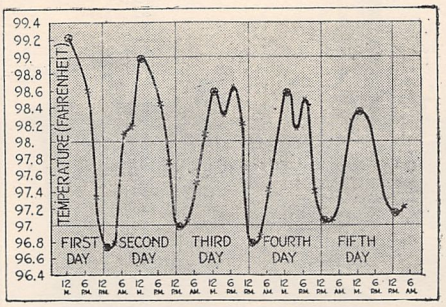
"I WAS extremely sluggish on the fifth and last day. I had lost all interest in everything—except sleep. I had to force myself to perform even the slightest movement, and I had to keep moving all the time or fall asleep on my feet. The experiment was becoming a nightmare.

"At 10 P. M. I was permitted to sit on my bed, unattended, and immediately I dropped over to the mattress, sound asleep. So I remained, almost as lifeless as a stone, for 10 hours. Then I awoke, arose, dressed myself; and went about my work as usual. I was not so active as I should have been, still I was able to work and to accomplish something. Within two days I was quite normal again, seemingly none the worse for my experience."



Asleep at Last! Almost as Lifeless as a Stone

At the end of his grueling five days of wakefulness, Dr. N. F. Fisher was permitted to sit on his bed unattended. "Immediately I dropped over to the mattress, sound asleep," he relates. "So I remained, almost as lifeless as a stone, for 10 hours." Here Doctor Fisher is seen in heavy slumber, while Dr. Nathaniel Kleitman, his co-experimenter, tests his pulse and blood pressure for significant changes



How Body Temperature Varied

This chart shows how the variation of Doctor Fisher's body temperature decreased as sleeplessness increased. The degrees of temperature (at left) are expressed in Fahrenheit. "Continued wakefulness probably would cause the body temperature to remain constant, and might result in death," Doctor Fisher concludes, at the end of the experiment

BOTH of the experimenters were tested periodically while they remained awake and after they had begun to make up their lost sleep. Blood pressure, respiration, the reflexes and temperature were some of the things tested, and the results of these observations have been summarized by Doctor Kleitman about as follows:

Sleep comes as a result of complete muscular relaxation. You can help bring on sleep by relaxing the muscles; you can ward it off by muscular contraction. But, after you reach your limit of fatigue, your muscles will relax automatically, and sleep will come whether you wish it or not.

Nervous fatigue produces muscular contractions that prevent sleep. Complete, "thoughtless" relaxation, then, is the goal to be sought by those who suffer from nervous insomnia.

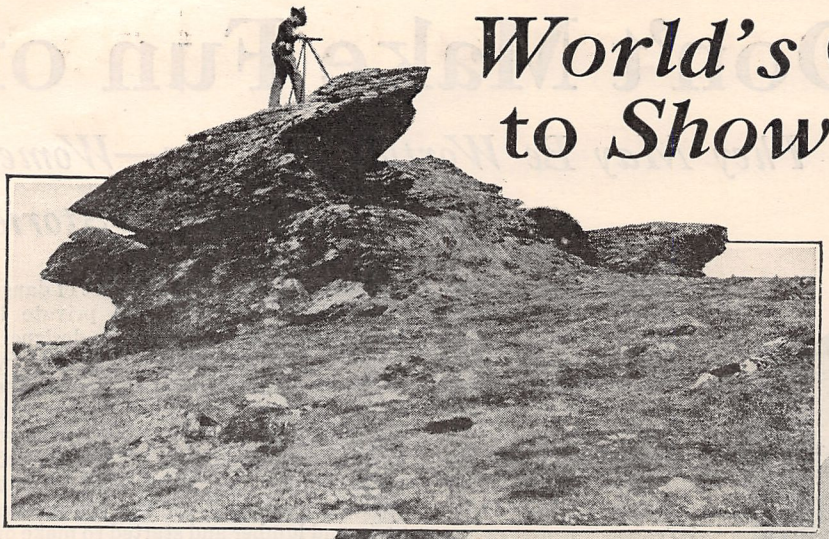
The respiration, rate of heartbeat, and blood pressure show a progressive decrease during prolonged wakefulness, but very few chemical changes take place in the blood.

Continued wakefulness probably would cause the body temperature to remain constant and might result in death.

World's Greatest *Map* to *Show* Your *Home*

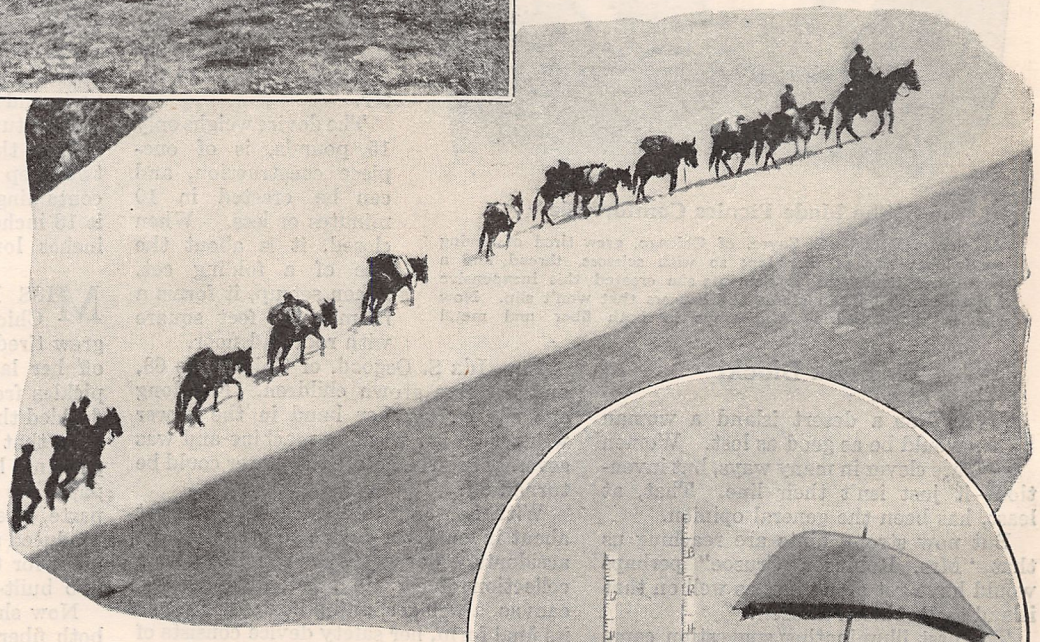
Vast Survey of U. S. Is a 70-Year Task

By Floyd Montgomery



Mapping the Heights

Here is one of Uncle Sam's map-makers surveying from a rocky knoll 11,000 feet up in the Sierra Nevada Mountains



A Stiff Climb in the Sierras

Daring adventure and untold labor go into the making of the world's greatest map. Here a pack train of the U. S. Geological Survey, which is making the largest map, is seen struggling up a steep slope in the high Sierras

THE recent passage of a bill by Congress enables the government to carry to completion the largest and most comprehensive map of the United States — a great mother map that will represent, when completed, 20 years from now, an accurate topographical survey of every square inch of the vast territory that comprises the United States.

This great map—the largest in the world—will not be in one piece, but will be composed of 6000 sections which, if placed together in one big pattern, would cover more than an acre of ground. So complete in detail will it be that anybody, living in any section of the country, will be able to find on the proper sheet the exact location of his house.

Delicate contour lines will draw the picture of the country's hills and valleys, plains and mountain ranges, canyons and waterways, including, even, its man-built landmarks. Using the map for reference, the route of a proposed project may be laid out without the engineer being on the ground. The only surveying necessary will be the actual job on hand.

What a treasure chart for the engineer who, seeking lines and levels for proposed penetration in unmapped areas, now must spend valuable time and often great sums of money for intricate surveying!

Work began on the survey for the map in 1879 and has progressed slowly, held back by lack of appropriations. Now, however, Congress has authorized the completion of the work and an appropriation of $950,000 for the survey in the first year.

The total expenditure, with state cooperation, is placed at $49,200,000.

Modern science in many ways aids in completing the map. Aerial photography plays an important part. The plane, carrying a photographer equipped with a panoramic camera, flies at an elevation of about 12,000 feet and the pictures are taken often enough so that they overlap. While the developing and photo-lithographing are in progress, control men make a few definite locations of known points, which are marked accurately on tracing linen and the work of fitting the aerial photographs begins.

The use of the airplane is in sharp contrast with the earlier days of the survey, when transportation and virgin country complicated the field workers' program of activity. Hostile Indians, too, were a cause for concern and very often surveying parties were escorted by detachments of United States soldiers as protection against possible attack.

The survey is a history in itself. Every line on the map will reveal much of romance and adventure for those who have had part in its making.

For example, a group of tiny lines define the contour of Mt. McKinley. Yet to obtain them, a company of men have struggled up the white heights in Alaska, laboriously packing surveyor's equipment up precipitous ascents, and have pitted their strength and wit against the forces of nature.

Again, there is designated on the map a minute area labeled "Mojave." Under a burning sun, surrounded by scorched desert land, another company has spent many hours sighting and marking in order that this area on the map might be inscribed truthfully.

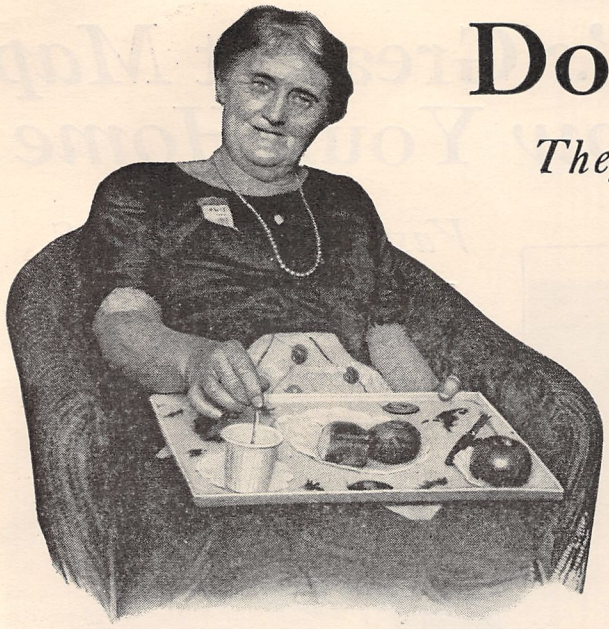
It is a tremendous undertaking. Yet when the last square inch of our vast country has been surveyed, there will have been completed a treasure chart of priceless value.

At Work under a Scorching Sun

Under the tropical sun of the southern plains, the engineer carries an umbrella to shade his work sheet while he maps the landmarks visible from his portable surveying elevation

Don't Make Fun of

They May Be Worth a Fortune—Women Pans—Astonishing Stories



She Made Picnics Comfortable

At picnics Miss P. C. Sayre, of Chicago, grew tired of having sandwiches slip off her lap; so with scissors, thread, and a few other household implements she created this inexpensive lap tray with built-in plates and saucers that won't slip. Now she is manufacturing the trays in both fiber and metal

By Fritz Blocki

CAST on a desert island a woman would be as good as lost. Women are clever in many ways, but invention—it just isn't their line. That, at least, has been the general opinion.

But now strong hints are reaching us that "Mrs. Robinson Crusoe" perhaps would have got along just as well on that island as Robinson himself.

The first illuminating suggestion came from a recent study of the records of the United States Patent Office. The result was astonishing. Every important sphere of industry, commerce, and the sciences was found to be represented in the thousands by inventions of women. Besides dish-drainers, clothes-sprinklers, and articles of adornment that one readily might associate with feminine efforts, there were engines, boilers, electrical apparatus, mining equipment, automobile parts, furnaces, marine compasses, in fact, there was hardly anything too mechanical or technical to be included.

Then, a few weeks ago, women had a World's Fair at Chicago at which women inventors had a special exhibit. Here was a second telling demonstration. From homes and laboratories in all parts of the country women came, bringing devices of their own that showed them expert in mechanics and invention.

MOST of the inventions, it was discovered, came about exactly as men's inventions—through recognition of a human need and a deliberate attempt to fulfill it.

There is Mrs. Virginia W. Collier, for example, who lives at Bloomfield Hills, Pontiac, Mich. One of her hobbies is swimming. Since she lives within motoring distance of more than 500 different lakes, indulgence in this sport was easy. But she found there was no suitable place for her and other swimming enthusiasts to prepare for the water. She needed a portable bath-house, and so she invented one.

First she made drawings. Then she procured sticks, canvas, tape, and the necessary tools. After many days of toil, she produced a model of what she desired—a tentlike portable canvas bathing shelter.

The device weighs only 15 pounds, is of one-piece construction, and can be erected in 10 minutes or less. When closed, it is about the size of a folding cot. When set up, it forms a room three feet square with roof and floor.

Mrs. Ida S. Osgood, of Chicago, is 63, and has five grown children. Not long ago she caught her hand in the power wringer on her washing machine and was severely injured before the power could be turned off.

With her hand still in a sling she set about inventing a device to prevent such accidents. For weeks she wrestled with a collection of curtain poles, rags, screws, canvas, a wringer, and a box of tools. In its final form, her safety device consists of two idle rollers on a steel frame that clamps over the top of the wringer. These rollers carry an endless canvas belt that conveys the wet clothes to and between the rubber rollers of the wringer. The device will keep the hands at least six inches out of danger.

"Madame Barnette," in private life Mrs. Henry Page Guyton, is a designer of women's clothing in Chicago. She was troubled because in her home there seemed to be no convenient place where she could keep her shoes out of the way and in good condition. The need of a wardrobe for her shoes suggested the name "shoe-robe." So she got hammer, nails, and lumber and started to make one.

Eventually she fashioned a neat little cabinet the height of a chair, containing two deep and roomy drawers capable of containing eight pairs of shoes each. It is 18 inches high, 18 inches wide, and 25 inches long.

MISS P. C. SAYRE, who lives in Chicago, likes to go on picnics, but grew tired of having her sandwiches slip off her lap while she tried to keep the pickles from rolling into the grass. She decided there was need for an inexpensive tray that would serve as a table on a person's lap. So she bought a stack of paper pie plates, sauce dishes, cardboard, paste, needles, thread, and scissors and produced a cardboard tray with a built-in plate for the main part of the meal and two built-in plates for salad and a cup.

Now she is manufacturing the tray of both fiber and metal. The fiber models are for picnics and buffet lunches. Metal models are designed for schools, hospitals, and similar institutions, where they will save the washing and breakage of individual dishes.

Mrs. Mark L. Day's husband is a manufacturer of humid-air radiator cabinets, while Mrs. Day is a poetess as well as a wife and housekeeper. Business frequently

A Housewife's Brilliant Idea

Keeping her husband's dinner warm on the radiator gave Mrs. Mark L. Day the idea for the two ingenious steel "radiator cupboards" shown above. The one at the right is for warming plates and food, while the one at the left is for warming baby's clothes and bath towels

Your Wife's Ideas

Have Invented Steam Engines and Pie of Feminine Ingenuity

A Crushed Hand Made Her an Inventor

After she had caught and severely injured one of her hands in the power wringer of a washing machine, Mrs. Ida S. Osgood of Chicago never rested until she had devised this remarkable safety appliance, the essential part of which is an endless canvas belt that conveys the wet clothes to the rollers of the wringer. Her invention, which she is holding, also is shown installed on the wringer at the left

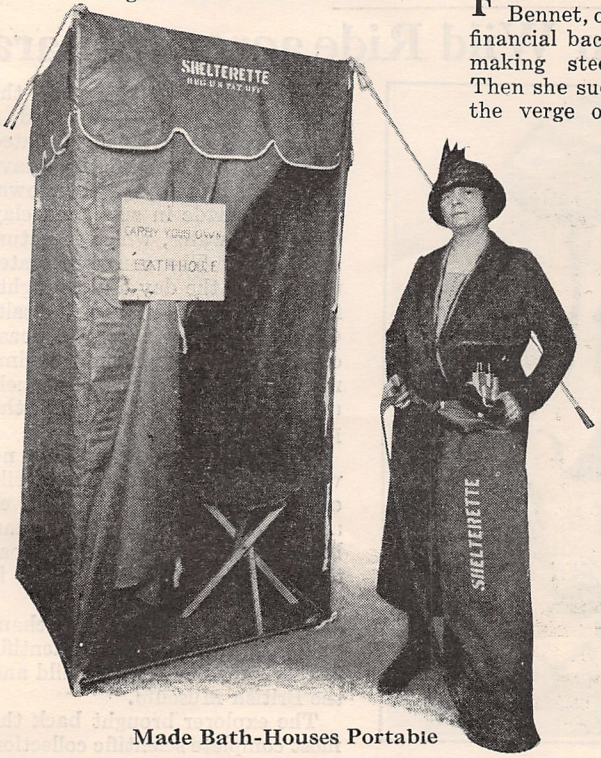
kept Mr. Day at the office until well after dinner-time. On these occasions Mrs. Day used to put his food in a covered plate and set it on a radiator, for she found this kept the food warm for several hours.

Appreciating that this scheme had commercial possibilities, Mrs. Day set to work to improve upon her idea. One of her husband's machinists constructed for her a special steel radiator cabinet of her own design with a cupboard containing several shelves at each end. Some evenings later she surprised Mr. Day with a new piece of furniture, a "radiator cupboard" in which an entire dinner service or meals for several people could be kept warm for half a day, if desired, without extra expense. Neighbors who saw the device requested duplicates. Now Mr. Day is regularly manufacturing Mrs. Day's radiator cupboard and Mrs. Day is a poet again.

IN DENTON, MONT., on a ranch that is 19 miles from the nearest railroad station, lives Mrs. O. L. McCracken and her family. Yet, isolated as she is, Mrs. McCracken not only made a unique contact with the world, but caused fame and fortune to seek her at her cabin door.

She noticed that the swollen streams and heavy spring rains exposed and washed out gnarled roots from the cottonwood trees that grew near by. Some of these weather-beaten roots took queer shapes. Some resembled animals, others little old men. She picked up some of the oddest of them, and by tedious hand work with crude tools made dolls of them.

The first storekeeper to whom she showed her dolls bought all of them. Soon she began to be known for her dolls, and before long orders started to seek her out. With the proceeds from her work she has sent her little girl through high school.



Made Bath-Houses Portable

A lack of bathing facilities at many a fine swimming hole in Michigan lakes inspired Mrs. Virginia W. Collier of Pontiac to invent this portable canvas bath-house. It is of one-piece construction, weighs only 15 pounds, and can be erected in about 10 minutes

FOR five years Mrs. Myrtle Stevens Bennet, of Chicago, furnished the chief financial backing for a Chicago company making steel barrels and containers. Then she suddenly found the concern on the verge of bankruptcy. To prevent this she took over the business herself, though knowing nothing about its details.

That was 15 years ago. Today she is still the active head of her company.

Miss Hélène Pachal, of Winnipeg, Can., is the only woman ceramic engineer in the world. She is a little wisp of a woman, weighing about 100 pounds, still in her thirties, with a pleasant countenance, sparkling eyes, and an unlimited store of energy. Several years ago she was a painter of china, which she sold to jewelers in New York. When the World War broke out, she lost most of her money in a European shipment that became stranded in Belgium.

Disheartened and financially embarrassed, she sold out her remaining stock and with the proceeds took a course in ceramic engineering. Then for nine years she engaged in one of the strangest hunts that ever took place. She was looking for clay. She prospected at thousands of places in the United States and Canada, only to be disappointed thousands of times.

One summer, near Assinaboia, Sask., she found the clay she sought—the only clay in America that naturally burns an ivory color. She kept her discovery a secret, and bought the land on which the clay hill stood on time payments over a period of several years. When her title was practically clear, she mined 12 tons—24,000 pounds—of clay alone by hand.

Miss Pachal intends to put up her own china factory in the not too distant future.

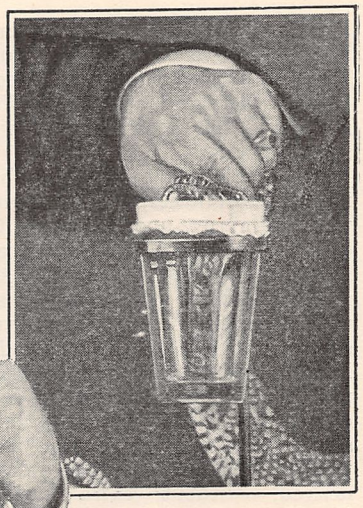
FOR a few women, invention is a full-time business. Miss Beulah Louise Henry is one of them. Six years ago she left her home in Memphis, Tenn., and went to New York to interest manufacturers in her idea of a "snap-on umbrella." This was a frame and handle to which different covers could be attached. Since then she has turned out inventions at the rate of a dozen a year. She has patented 33 of them.

One remarkable characteristic of most women inventors is that they are not particular about tools. Almost anything will do, which demonstrates their inventiveness all the more effectively. Look, for example, at the equipment of Harriette Ensley Hodgson, another woman with a long string of inventions to her credit. Her workshop is her home in New York City. A list of her tools consists of the following: Wire, hammer, flatiron, clippers, punchers, glass cutter, nails, screws, hooks, alcohol, lamp, sealing-wax, wood, cardboard, paper boxes, stickers, glue, cords, dyes, canvas, rings, felt, and tape measure.

"If you want to make something badly enough," explains one woman inventor, "you can do it, even if you have only a hairpin to start with."

Robbing an Angry Rattler of Deadly Venom

Snake Poison Used for Serum



Above: The correct way to hold a rattler if you don't want him to bite you. Charles Snyder, of New York City, is shown preparing to make the snake angry enough to strike and deposit its venom into the silk-covered glass. Center: A remarkable picture of a rattler's jaws, showing the poison fangs caught on a pencil that is held by Mr. Snyder

Darting its fangs through the silk cover, a thoroughly roused six-foot snake will release from six to eight drops of venom every two days

SQUEEZING a snake to make it angry is a task that very few of us would choose for a pastime. In the photographs above, Charles Snyder, a snake expert of New York City, is demonstrating how he handles a huge rattlesnake to induce it to discharge its venom into a glass container.

The poison is used for experimental purposes and in the manufacture of a serum for treating snake bites. Large quantities are exported annually from zoological gardens in the United States to South America for the latter purpose.

The snake is teased until it is angered, when it strikes out, and its head is directed to a silk cloth stretched tightly over the top of a glass. Its fangs penetrate the cloth and the venom is deposited in the glass. A snake six feet long will deposit six or eight drops. Its glands will secrete this quantity in about two days. Considerable skill is required to handle the big rattlers so that there will be no chance of being struck by the poisonous fangs.

White Men Outlive 32 Camels in Wild Ride across Sahara

THE hundreds of tales written about the Sahara Desert tell only of its edges. The interior of that great waste, with its roving robber tribes, strange villages, and queer beasts are as little known as desolate polar regions.

For this reason Captain Angus Buchanan, British explorer, who has recently arrived in America, brings stories of absorbing interest. He and a camera man were the first white men ever to cross the Sahara on camels. Starting from Nigeria with 16 natives and 32 camels, they trekked northward 3500 miles to Nigeria. The arduous journey took 16 months.

Only two of the natives who set out, remained at the end of the journey. The rest dropped from sickness or ran away in fear of bandit raids. The camels in the caravan died one after another until only one remained. This one, used by Captain Buchanan, died two hours from the point of final destination.

On the long journey the explorer visited the strangest town in the world—a Saharan city made entirely of salt! This is in the Oasis of Fachi and is fortified, a veritable desert citadel. Isolated from the world, the natives have set up an industry of their own. Into pits made in sunbaked clay they pour water, which is naturally salty. The sun evaporates this during the day and at nightfall the natives scoop up the salt. Caravans carry it to the coast over a trail marked from time immemorial by carcases of camels and men fallen by the way in the pitiless sun.

Captain Buchanan, who, with his camera man, was the first white man to cross the Sahara by camel, is seen here in company with a baby gazelle and a baby fox. His 16-month journey, full of danger from both man and nature, resulted in the discovery of many birds and mammals unknown to the rest of the world

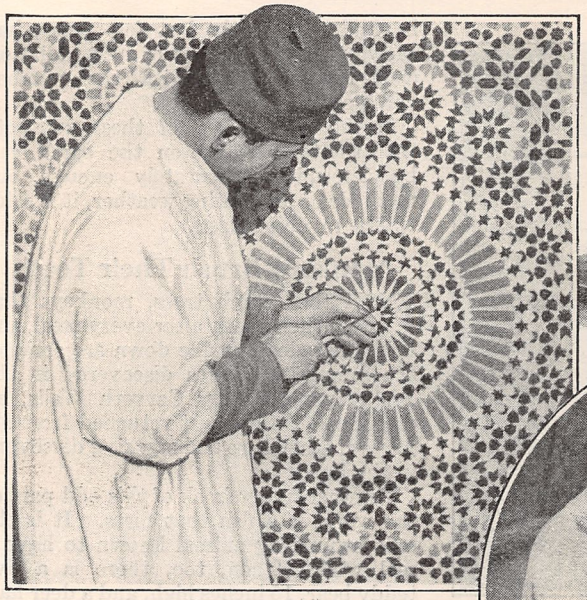
The Fachi men, for reasons no white man knows, wear black veils over their faces. These veils never are removed. Captain Buchanan believes that the principal occupation of this mysterious tribe is robber raids.

The object of Captain Buchanan's expedition was scientific research for Lord Rothschild and the British Museum.

The explorer brought back the most complete scientific collection gathered from the Sahara. One of the most valuable treasures is the skin of a "burrowing cat," the only specimen in any collection

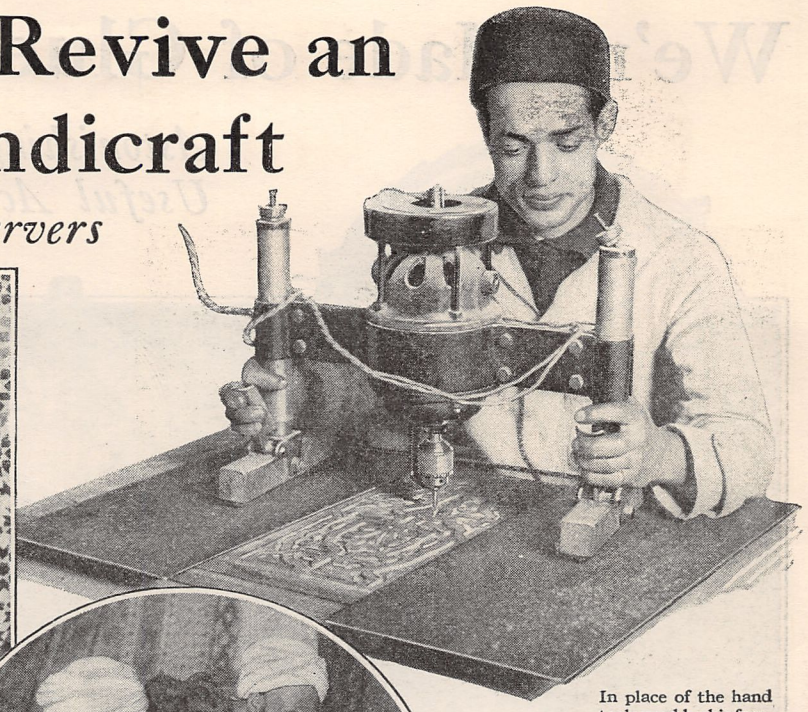
Power Tools Revive an Ancient Handicraft

Science Aids Moorish Carvers



A Moorish wood-carver putting finishing touches to an elaborate conventional wall decoration

Interior decorators from Morocco carving intricate panels for the new Moslem mosque in Paris. They are famous for their skill



In place of the hand tools used by his forefathers, this Moorish artisan uses a motor-driven router to trace the outlines of his design and cut out the bulk of the wood, finishing by hand

ONE of the most picturesque examples of how twentieth-century machinery is duplicating and reviving ancient craftsmanship is found in the work of carving elaborate decorations for a Mohammedan mosque under construction in Paris, France. There skilful Moorish wood-carvers, imported from Morocco to fashion the gorgeous conventional patterns that adorn the interior of the mosque, are making use of electric power tools to save time and labor.

Motor-driven routers nowadays are proving effective substitutes for the slow, laborious handwork of tracing the outlines of the designs and removing the bulk of the wood. Other power tools of the kind employed in modern factories also are used.

The delicate work of finishing the designs, however, is left to the skilled hands of the Moorish artisans, whose race is famous for its exquisite architecture and decoration. Months of labor already have been spent in carving the intricate and richly wrought panels.

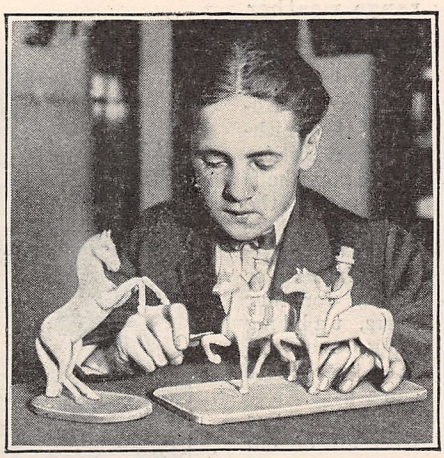
New Color-Print Process

COLOR reproductions that cannot be distinguished from the originals are claimed for a new color-printing process recently demonstrated at the press of William Edwin Rudge at Mount Vernon, N. Y., under the direction of the Smithsonian Institution. A 100-per-cent rag paper, such as was used in the Gutenberg Bible, together with special waterproof inks, are used in the printing—a three-color process with modifications. The paper is printed upon while damp.

Prehistoric Workshop Found

A COMPLETE prehistoric workshop containing 17 heaps of flint tools and weapons numbering altogether 4000 pieces recently was discovered by British and American geologists at Frindsbury, Rochester, in the Valley of Medway, England. The tools, according to reports of the find, include hand axes of large flint flakes, hammer stones of quartz, and large rounded pieces of flint.

The discovery was made in a queer saucer-shaped depression in a chalk cliff, and the relics are believed to date from mid-pleistocene times—the age supposed immediately to precede that of man.



Boy Is Champion Whittler

EVERY day after school Albert Schuknecht, a 13-year-old grammar-school pupil of Chicago, gets out his penknife and whittles figures of men and animals, while friends look on with admiration. He has been acclaimed the champion whittler of his city.

Figures of horses make up the largest part of his collection. The young sculptor has received good offers for his models.

Ancient Bronzes Restored

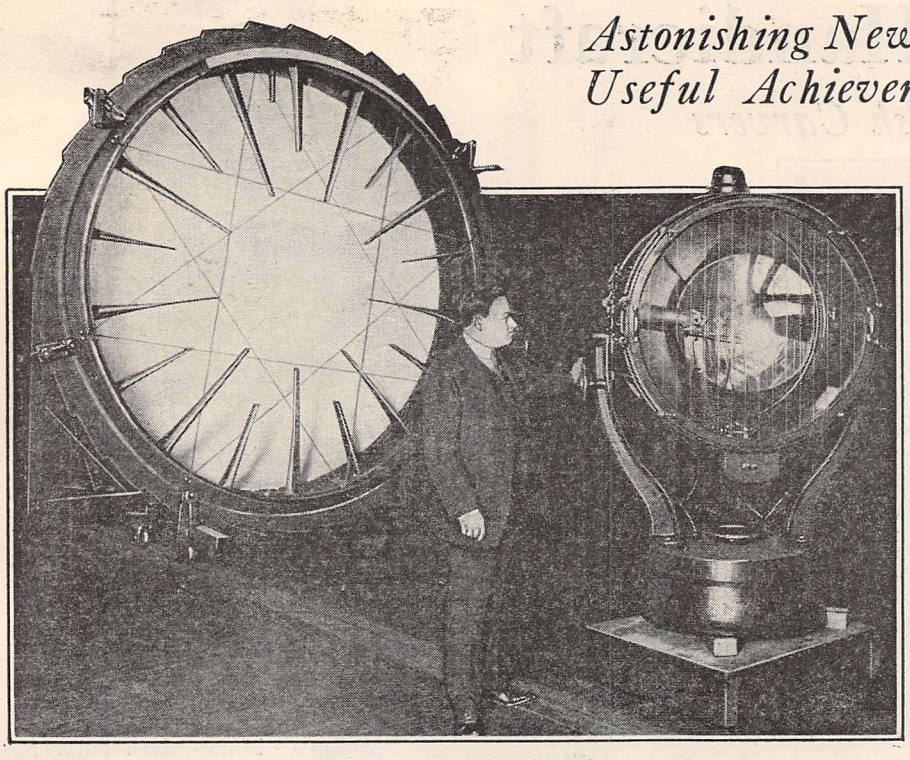
VALUABLE ancient bronzes that had almost lost their identity through rust are being restored by a new electrochemical process recently developed at the School of Mines at Columbia University by Prof. Colin G. Fink. The process is said to return rust into metal, restoring shape and detail to genuine antiques and exposing fake ones offered for sale to museums as antiques. More than 600 objects of bronze, silver, and alloys have been treated by this method.

Celluloid Hippo for Museum

A CELLULOID hippopotamus is the latest thing in museum art. Heretofore the hippo has defied the skill of taxidermists because its skin could not be reproduced with convincing realism. But now L. L. Walters, of the Field Museum of Natural History at Chicago, Ill., has discovered a method of using celluloid to produce translucent color effects that are said to give almost the semblance of living flesh and blood. Using this method he is constructing a remarkably life-like reproduction of a hippo, in which the real hairs are embedded in the celluloid.

We're Made of Glue, Say Chemists

Astonishing New Discoveries and Useful Achievements in Science



Huge Lamps like This Light Niagara Falls

The plunging waters of Niagara Falls now are being illuminated by 24 huge searchlights of the type pictured above. These lights, installed a few weeks ago, cast 1,300,000 candlepower on the famous falls. The picture shows W. D'Arcy Ryan, director of the General Electric Illuminating Engineering Laboratory, testing the searchlight with the aid of the photometer seen behind him

FROM the discoveries of today in the world's laboratories and workshops grow the every-day utilities and necessities of tomorrow. New theories of scientists that amaze us now, become the actualities of future years.

For that reason, if for no other, it pays to become acquainted with present-day developments in scientific research and experiment. It is to help you keep pace with the advance of science that we publish here a summary of the month's important contributions to useful human knowledge.

Man Also Is Like Rubber

PERHAPS you thought that you were made of dust. You are not. You are made of glue. At least that is what a number of leading chemists now tell us.

The scientific term they use to describe our make-up is "colloid." That means a jelly-like substance containing suspended matter. Solids, liquids, and gases—that is the way we learned to classify matter in school. But not long ago a new range of glue-like substances was added—the colloids. Our tissues, muscles, and all parts of the body fit in with this description, scientists claim.

Clay, milk, and almost all other food, animal, and plant products, are colloids, too.

At the University of Pennsylvania interesting experiments have been made in dissecting microscopic living cells. It was found that protoplasm in cells will stretch and jump back to its original position just like a rubber band. In fact, Dr. H. L. Fisher, formerly of Columbia University, told the American Chemical Society recently that the principal difference between man and rubber is that rubber can be produced artificially.

The Sun and the Weather

WITHIN a few years we may be able to tell months in advance that a cyclone is coming on a certain date, predict accurately storms at sea, and determine when the last frost of spring will appear. To make such long-range weather forecasting possible, an expedition led by Dr. Charles G. Abbot of the Smithsonian Institution is going halfway round the world. It will remain at some point in Asia or Africa for four years, taking daily measurements of the sun's heat.

Science says that all of our weather — rains, snows, storms, and droughts— has its origin in the slight variation of heat we get from the sun. Doctor Abbot, from work done at two desert stations, one in Arizona and one in Chile during the last few years, has shown that the amount of heat radiation from the sun varies with the number and position of sunspots.

If the relationship of these sunspots with the temperature on the earth can be determined accurately enough, our methods of forecasting weather, it is said, will be revolutionized.

Monkeys Brush Their Teeth

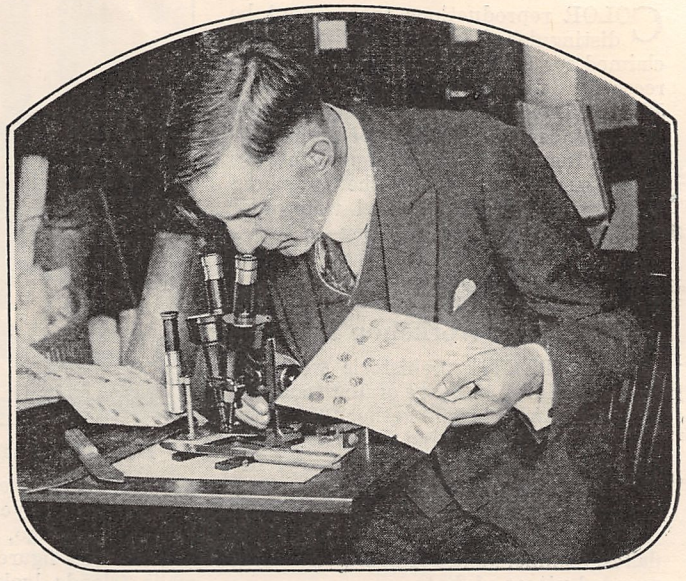
FISH that climb trees, monkeys that brush their teeth after every meal, and birds that sleep upside down are some of the strange creatures discovered in the Malay peninsula by Carveth Wells, an explorer. He has just returned from six years of adventure and amazing discovery in the jungles.

Another funny freak of this odd part of the world is a fish that flirts. It is the only swimming animal known to have a real wink. Then, too, there is a live teddy bear, 15 inches high, and a deer half that high, which would fit a coat pocket.

Radon—Rarer than Radium

A NEW substance, radon, has been discovered, which costs $5,000,000 an ounce. Although it is the most expensive substance in the world, its use will make the treatment of cancer cheaper. It is a gaslike emanation of radium and will be cheaper to use than radium because it is 160,000 times as active. From $25 to $50 worth of it, explains Dr. Charles H. Viol of Pittsburgh, will do the same work as from $2000 to $4000 worth of radium.

Radon is put up in tiny glass "seeds."



Discovers Finger-Prints Can Be Forged

Surprising proof that fingerprints, believed to be the one infallible means of identification, can be forged, has just been offered by Milton Carlson, world famous handwriting and fingerprint expert, in connection with a Los Angeles legal case. He is seen here examining a knife on which, he claims, fingerprints were forged to confuse investigators of the crime

the thickness of a human hair. The supply of it is practically inexhaustible, but it has the disadvantage of short life. It loses half its activity in about four days, while radium maintains half of its weight at the end of 1700 years.

A War Against Rust

WE CALMLY have been letting rust and corrosion destroy more than $300,000,000 worth of metals every year. Noted chemists throughout the country now are united in warfare against this needless waste.

One reason that so little has been done about it, up to this time, is because we did not know exactly what caused rust. Investigations described before the American Chemical Society recently showed that rust is due to currents of electricity set up in metals by the action of air or water in contact with it, or the two mixed.

Great plumbing economies have been effected, it was announced, by passing water through scrap iron before letting it enter pipes. The scrap iron exhausts the water's rusting power so that it does little harm in the pipes.

Where Brains May Handicap

RECENT investigations show that too much intelligence is a detriment, rather than a help for certain types of work. In a study of 375 young girls placed in industrial positions in New York City, it was found that bright girls found uninteresting tasks irksome, soon became restless, and looked for other jobs, thus adding to the large turnover of labor. Less intelligent girls were steadier workers.

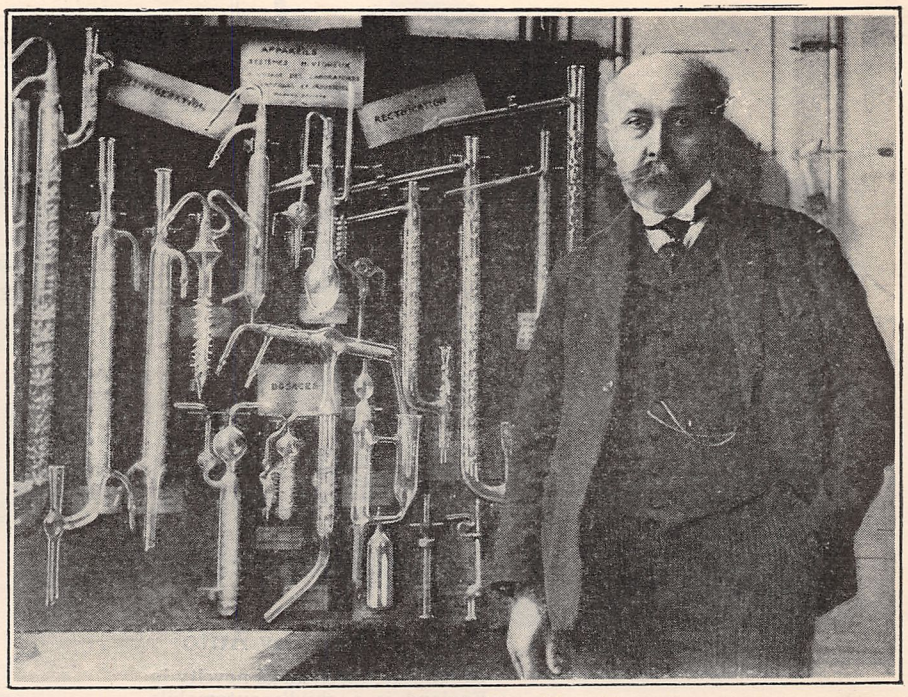
Girls whose mental age is 7½ years, make satisfactory packers of small articles. The simplest sewing-machine jobs, such as window-shades or other simple work, can be done by girls with a mental age of 12 years, but straight-seam sewing and sewing on braids requires an intellectual level of 13 years.

A Rush for Precious Water

A RUSH like those of gold-prospecting days is taking place in France toward Estreys, a village so small that you can find it only on a large map. The object of the rush is far more valuable than gold to those flocking into the place. It is medicinal water.

Government chemists recently reported that in this town no case of cancer or tumor ever has been known. Investigation showed that the water used by the inhabitants for drinking and washing clothes was a mineral water containing extraordinarily valuable properties.

When the water was analyzed, chemists were startled to find that it was the most highly radioactive water known to exist in the entire world. Invalids suffering with cancer are therefore seeing in it a possible cure, and are flocking into the little French town. The many strangers in Estreys give the town the appearance of a perpetual fair.



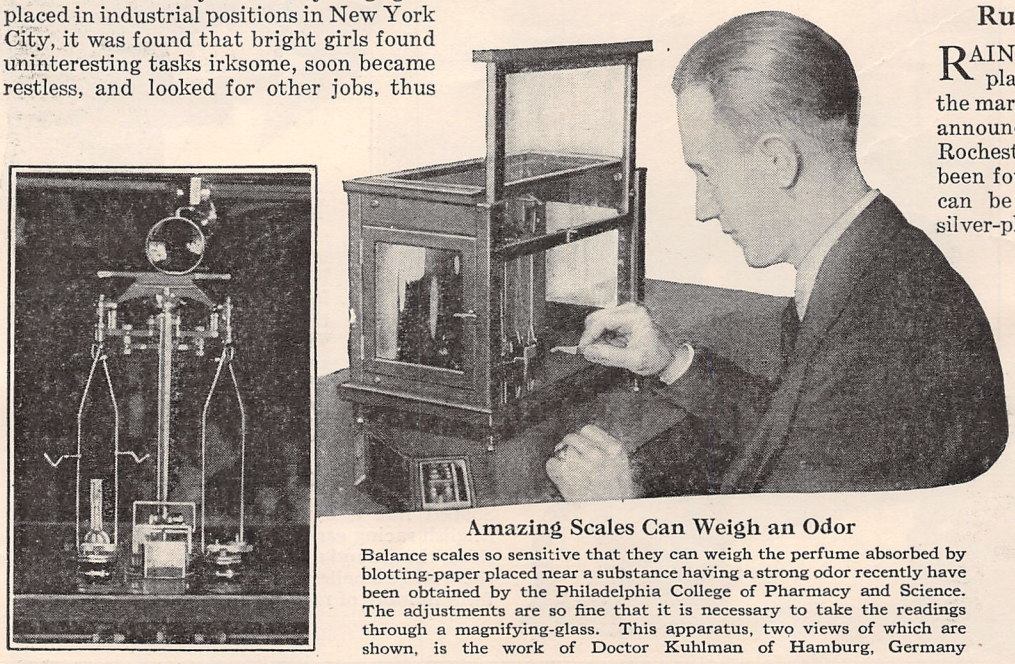
Wins High Honors for Making Glass Utensils

In recognition of his services to science through his skill in making the various kinds of glass apparatus used in chemical research, Henri Vigreux, a Paris laboratory assistant, recently was awarded the Cross of the Legion of Honor. Early in his career he was scalded badly by the explosion of a distilling flask, and this accident led him to improve the laboratory utensils of which he had charge. He is shown here with a number of his creations, which are familiar to many laboratory workers

Rubber-Plated Coats Next

RAINPROOF coats, dresses, and suits plated with rubber may soon be on the market as the result of a new discovery announced by Dr. S. E. Sheppard of Rochester, New York. A method has been found, he declares, in which objects can be rubber-plated just as metal is silver-plated. Articles of clothing can be made complete, then immersed in a bath and coated with rubber. There would be no seams, then, to rip or leak.

Each minute particle of rubber suspended in the milky sap of the rubber tree possesses an electrical charge, Doctor Sheppard explains. It is this that makes the plating process possible. Garments covered with the rubber may be produced in any color.



Amazing Scales Can Weigh an Odor

Balance scales so sensitive that they can weigh the perfume absorbed by blotting-paper placed near a substance having a strong odor recently have been obtained by the Philadelphia College of Pharmacy and Science. The adjustments are so fine that it is necessary to take the readings through a magnifying-glass. This apparatus, two views of which are shown, is the work of Doctor Kuhlman of Hamburg, Germany

Danger in Blues

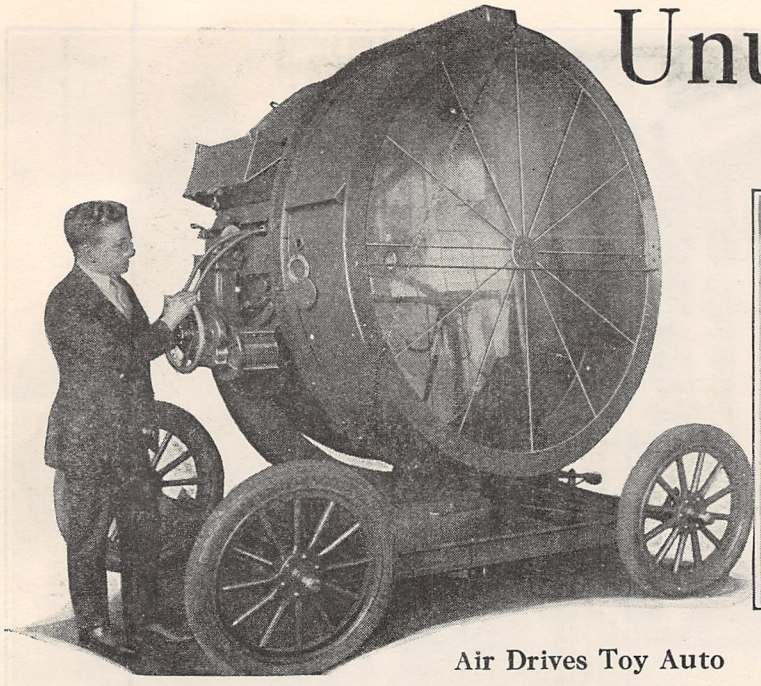
GETTING the blues is a danger signal, just like a red flag on a railroad track, warns the National Committee for Mental Hygiene. That doesn't mean "Monday-morning blues," but prolonged mental depression, when a person is constantly depressed.

A study of 167 cases of suicide in Massachusetts recently, showed that almost one-third were the result of mental disease, and depression was an outstanding symptom in the cases.

If your friend is blue all of the time, don't advise him to "cheer up" or travel. That will do him no good if he really has a mental illness, says the committee. Diagnosis by a competent psychiatrist and intelligent hospital care are the only means by which such a person can be helped toward a cure.

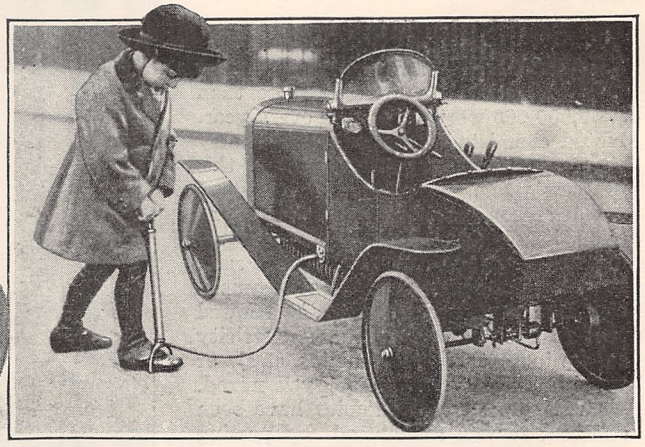
Unusual Creations

An Array of Surprising New



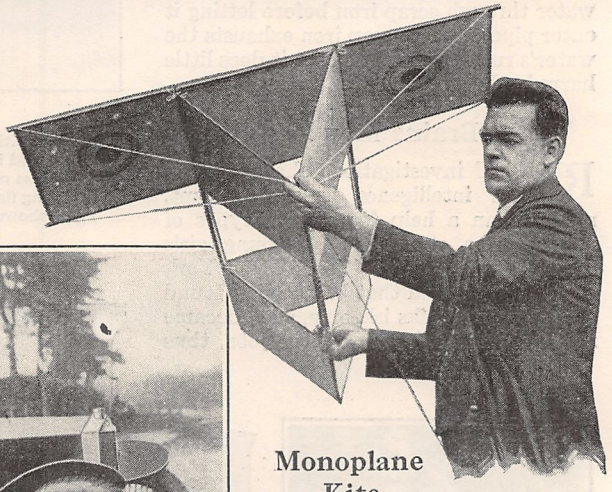
A Giant Searchlight

This new 1200-million candle-power portable Sperry search-light, designed for flying-fields, is said to be capable of throwing a powerful beam six miles and spotting objects at a distance of 30,000 feet



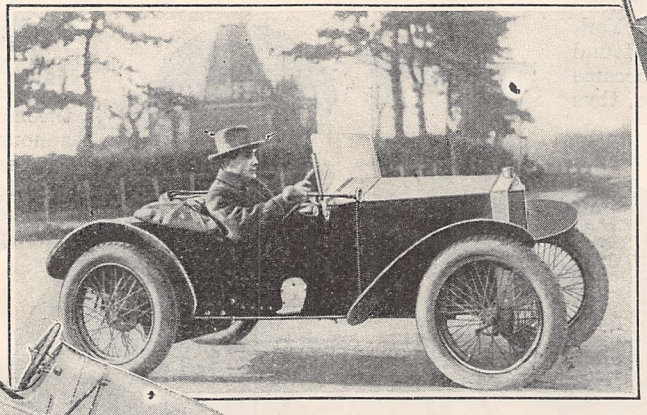
Air Drives Toy Auto

An unusual mechanical novelty in England is a child's automobile driven by a compressed-air cylinder in the chassis. This cylinder is charged with a hand pump, as shown at the upper right corner



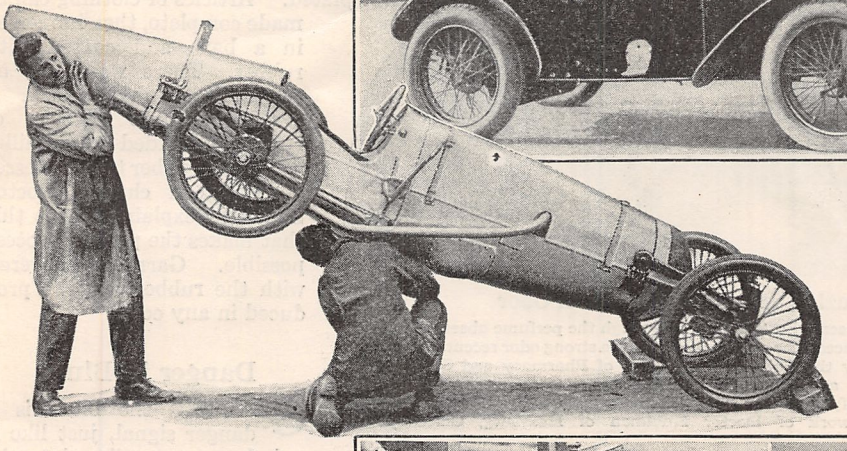
Monoplane Kite

Here is Perry Hale, former Yale football star, with his new kite that flies like a monoplane. A wing in front adds to the lift of the triangular kite. It can be flown at different angles, he says



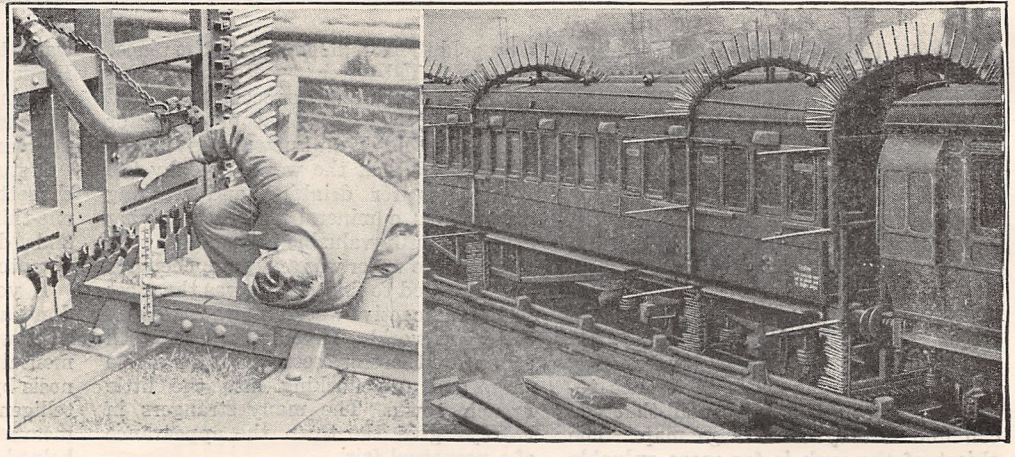
English "Flivver"

Fifty miles on a gallon of gas is claimed for a new English "flivver" (shown at right)



Smallest Racer Resembles Beetle

Shaped like a beetle, the remarkable new English racing car pictured at the left almost skirts the ground as it travels. It is said to be the world's smallest racing car, and is entered for a number of races in Europe this summer

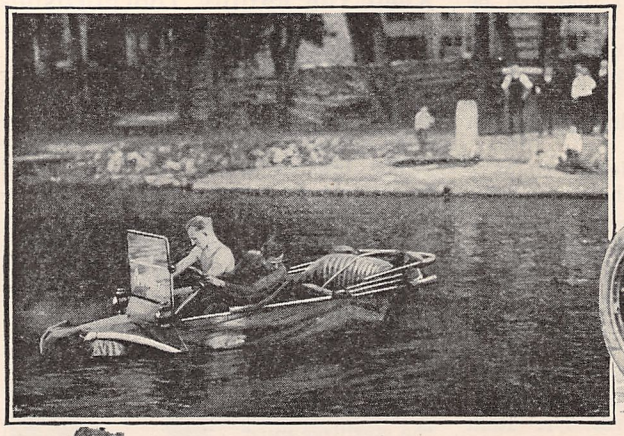


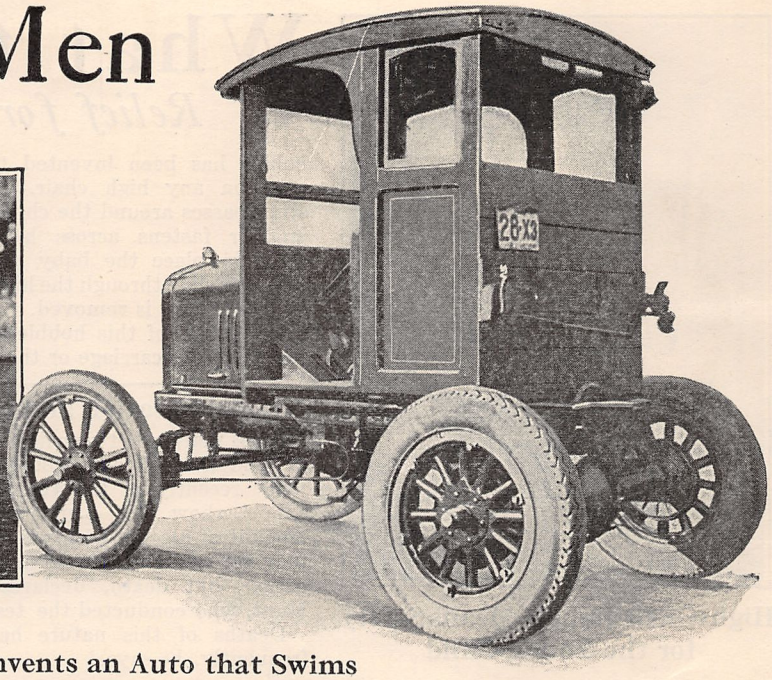
A "Hedgehog" Train

To determine precisely whether new rolling stock will clear safely tunnels, bridges, or other objects along the track, the Southern Railway recently devised the odd "hedgehog" train shown at the right. One of the cars is equipped with spikes or templets adjusted to represent the over-all size of any new stock. The first picture shows a workman taking measurements after a number of templets have been knocked back by an obstacle

# of Ingenious Men

Machines and Inventions





Invents an Auto that Swims

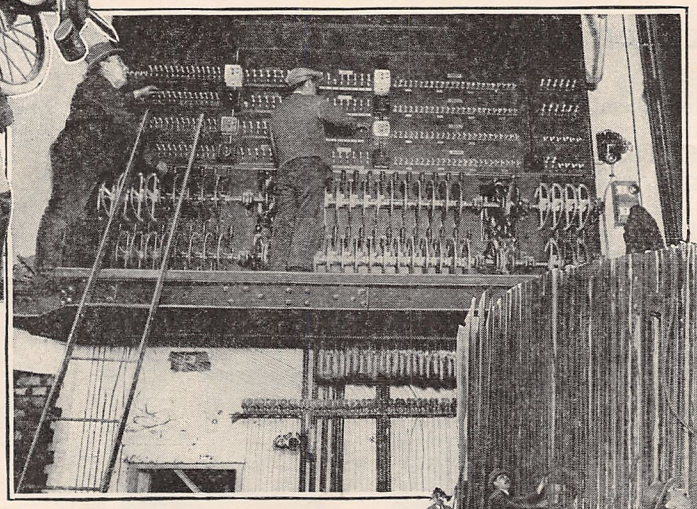
The swimming automobile pictured at the upper left is the unique invention of a University of Wisconsin student, James Douglas. A canvas hull is fitted around and under the car. The propeller is driven by the auto engine, while disk wheels on the fore part guide the automobile

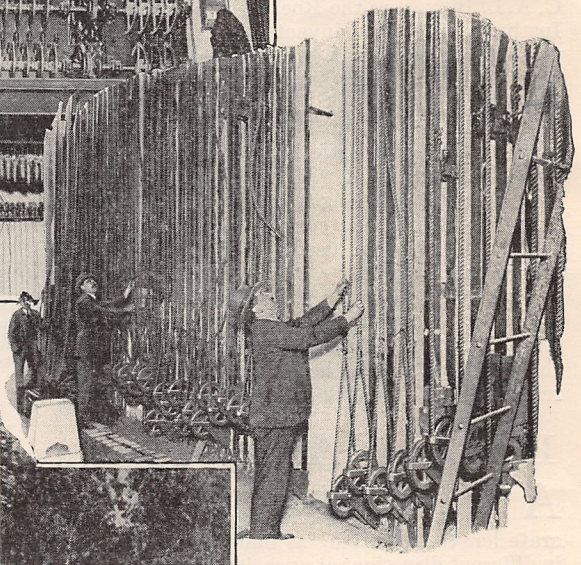
"Sawed-Off"

For hauling shipments of motor-cars from ships to warehouses, this odd "sawed-off" tractor was devised recently by a Providence, R. I., automobile dealer. In reality, it is a Ford truck cut in two. Its length is only six feet from hub to hub, making it possible to turn around easily and quickly in narrow space

Folding Bicycles

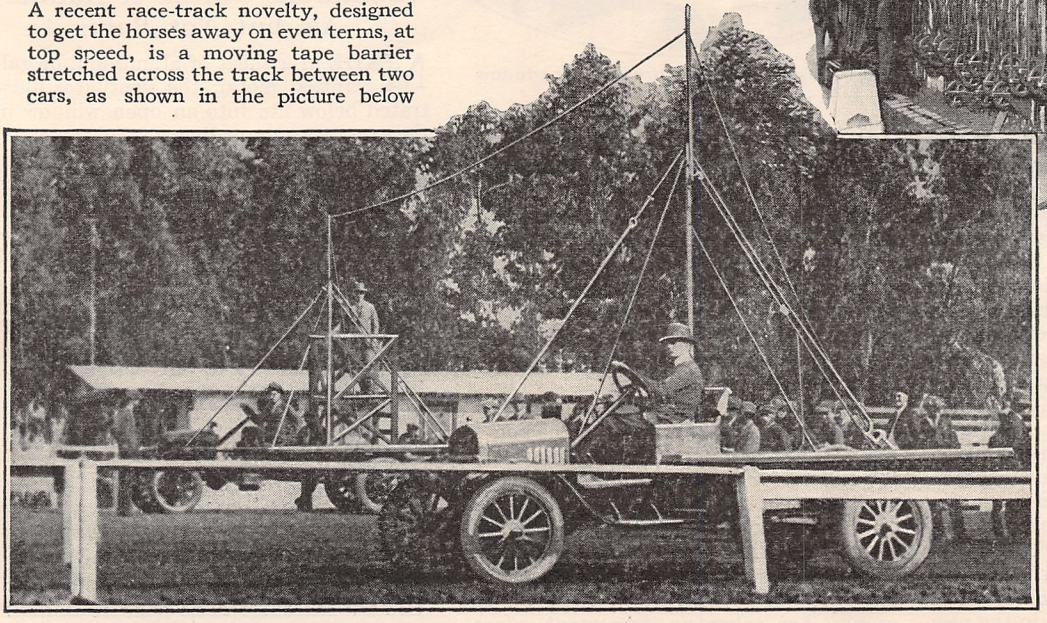
A light, collapsible bicycle that can be strapped on your back in climbing hills, and unfolded for coasting down them, is a Scotch invention





A Moving Race Barrier

A recent race-track novelty, designed to get the horses away on even terms, at top speed, is a moving tape barrier stretched across the track between two cars, as shown in the picture below



Stage Mechanics

The most elaborate stage machinery in the world is said to have been embodied in the new Empire Theater at Liverpool, England. The upper picture shows the huge electrical switchboard with more than 300 switches controlling 1000 stage lights. In the lower illustration are seen some of the 90 counterweighted lines for lifting scenery

What the Inventor

Relief for the Sick, Aid for the Mother

High-Chair Hobble Means Safety for the Young Child

MOTHER goes out of the room for a moment. Baby climbs up in his high chair and overbalances. A crash! Baby has had a nasty fall.

To prevent accidents such as this, a hobble has been invented that can be used on any high chair. One leather strap passes around the child's leg, while another fastens across his lap. With these in place the baby cannot climb, kneel, or slide through the high chair, even when the tray is removed.

Variations of this hobble are made to suit the baby-carriage or the automobile.

Intoxication and Death

THE margin between deep intoxication and death is dangerously small, tests made recently at the Harvard Medical School, show. If a man takes a large amount of alcohol within a short time, he may get enough to cause not only intoxication, but death, declares Dr. Reid Hunt, who conducted the tests.

Deaths of this nature have resulted frequently, he says.

What a Reader Says

POPULAR SCIENCE MONTHLY is filling a long-felt want in this neck of the woods.—W. J. M., San Diego, Calif.

Keep the Family Toothbrushes in Germproof Condition

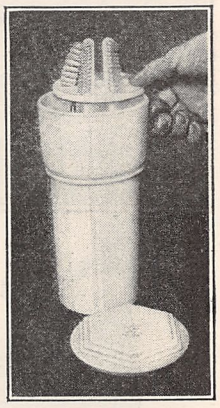
A PORCELAIN sterilizer that will accommodate six toothbrushes may be hung in a supporting ring from the bathroom wall.

The brushes are hung in numbered holes in a disk over a germicidal solution at the bottom of the container.

The ingredients of this liquid are volatile and it is the rising fumes that sterilize the brushes.

The solution in the sterilizer must be renewed once a week.

By this means the toothbrushes of the entire family may be kept continually in a germproof condition.



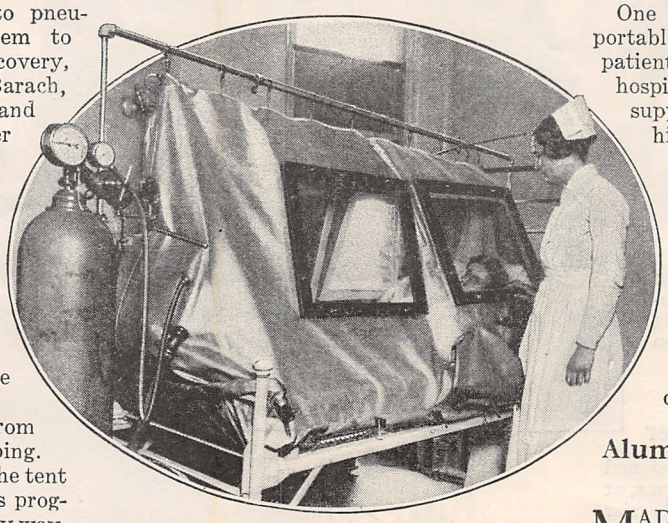
Toothbrush sterilizer

Portable Oxygen Tent Aids the Recovery of Pneumonia Victims

TO SUPPLY pure oxygen to pneumonia patients, enabling them to breathe freely, and thus aiding recovery, two New York doctors, Alvin L. Barach, of the Presbyterian Hospital, and C. A. L. Binger, of the Rockefeller Institute, recently invented a portable oxygen tent, which is now used by the Presbyterian Hospital.

The tent is set up indoors, suspended over the patient's bed by an iron framework, with a rod that runs the full length of the bed, supporting the curtain or tent. The material used for the tent is balloon cloth.

Oxygen is fed to the patient from a tank through rubber tubing. Through windows in the side of the tent the nurse can watch the patient's progress without disturbing him in any way.



Nurse observes patient through tent window

One of the great advantages of the portable tent is that in the event of the patient's being too ill to be moved to a hospital, the same equipment can be supplied and erected over the bed at his home.

AT A recent convention of the American Toothbrush Manufacturers' Association it was said that people in the United States use 40,000,000 toothbrushes yearly, whereas, to keep their teeth in really good condition, they should use 330,000,000, the life of even good bristles being only three months.

Five-Lens Aerial Camera Aids Air Mapping

A NEW type of airplane camera for mapping purposes, having five separate lenses and taking as many pictures in different directions at once, is now being constructed for the U. S. Army Air Service. According to Major J. W. Bagley, of the Corps of Engineers, it is expected that its use will facilitate the interpretation of aerial photographs and increase the accuracy with which they may be used as maps.

Previously three-lens cameras have been used that can photograph the region directly beneath the plane and at each side, but a four-lens camera has been developed that in addition photographs the territory behind the aviator. This aids in orienting the photographs with respect to each other when they are combined to form the map. The fifth lens in the new camera will be used to cover the region ahead.

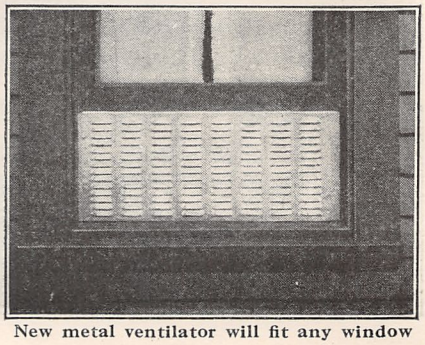
The use in the air service of a new and faster film lengthens the part of the day that aerial photographs can be obtained satisfactorily, according to Major Bagley. Formerly it was necessary to have a bright sun from 20 to 25 degrees above the horizon, a condition that exists only in the middle of the day.

With the new film it is possible to get satisfactory photographs when the sun is only 10 degrees high. The new film makes it possible for an aerial photographer to start early in the morning in midsummer and to work until five o'clock in the afternoon. The photographic day thus has been nearly doubled. In many other forms of observation work, aerial photography has taken an important place.

Aluminum Ventilator Admits Air but Not Rain

MADE of a sheet of aluminum, or galvanized metal, the ventilator illustrated below fits into an open window in the same way an ordinary window-screen does. Rows of hooded vents admit air, but it is said they prevent a direct breeze or draft, and keep out rain.

The ventilator has an adjustable extension on each side to provide for different widths of windows.



New metal ventilator will fit any window

Is Doing for You

A New Exerciser, and a Handy Switch

Punching Bag Attached to Board Is New Health Builder

A PUNCHING bag attached to a supporting board is a new exercising device said to be especially beneficial in promoting deep breathing and in exercising every muscle and ligament of the body. The handles under the board are grasped in the hands and the arms worked back and forth like pistons, first from the chest outward and then above the head and back to the chest, to make the bag hit the board at regular intervals. Other movements are used, to suit the person's needs.

Using the exerciser

Have you entered The "WHAT'S WRONG" CONTEST? See page 19 of this issue of Popular Science Monthly.

Water Heater Is Controlled from Bathroom or Kitchen

TURN on a switch upstairs and it will light the hot-water heater downstairs. This new switch, installed in the kitchen or bathroom, is designed to save trips to the basement whenever hot water is desired.

It turns the heater off and on automatically. When setting it, the upper pointer indicates the number of minutes one wishes the heater to burn. The lower pointer is used to turn on the burner. A clock inside the device records the minutes until the specified time is up, when the heater is turned off. This automatic heater control eliminates danger of possible explosion from an overheated tank.

Upstairs switch turns on basement heater

Hospital Surgeons Wear Flashlight Headgear in Emergency

AN ACCIDENT to the electric-light plant of a hospital in England brought about a new adaptation of electric flashlights. In the midst of an important operation the lights went out and all work had to cease until emergency lights could be found.

To avoid repetition of such a serious predicament, small electric lamps were devised to be worn on the surgeon's forehead. Carrying the battery in his pocket, a surgeon thus is ready for the emergency should the lights go out. Or, when he wishes special illumination upon a part of his work, the headlight can be utilized.

Adjusting headlight to the pocket battery

Better X-ray pictures of conditions in the lungs, due to elimination of blurring motions, are promised as the result of an invention recently announced by Dr. F. Maurice McPhedran and Chas. N. Weyl, of the University of Pennsylvania. The difficulty with many X-ray pictures, Doctor McPhedran explained, is that the beat of the heart causes motion, and only pictures taken during the brief pause between beats are of real value in diagnosing disease. The new machine operates in such a way that the photographic plate is exposed only when the heart is quiet, so that all pictures are taken under uniform conditions, and at the most favorable instant for getting the best exposure without blurring or distortion.

Chair on Bowl Foundation Keeps Baby Out of Mischief

THE baby can roll around, stoop, reach, stretch, and exercise all his muscles in the new chair with bowl-shaped bottom. It is so weighted that it cannot tip beyond a safe point.

Baby gets plenty of motion from chair

Body Fatigue Poison Is Still a Mystery

THAT hard physical labor causes fatigue has been known for hundreds of thousands of years, yet the immediate cause of fatigue remains still a mystery. When, in comparatively recent times, physiological chemistry undertook to solve the problem by investigating the chemical processes taking place in the muscle tissue during strenuous work, it was found that the tone of the muscle tissue, slightly alkaline in a normal state of rest, becomes more or less acid after vigorous exertion, and that a number of chemical substances, believed to be waste products, are formed in the tissue during the period of muscular exertion. Lactic acid, the principal of these waste products, was for many years believed to be the immediate cause of fatigue.

It was found that animals that had had lactic acid injected into their muscles displayed all the symptoms of muscular fatigue, including a temporary falling of their body temperature. When it was discovered, however, that a much greater effect was produced by injecting, in place of pure lactic acid, liquid squeezed out of fatigued muscle tissue, the investigators were led to the belief that this liquid contained a specific fatigue toxin that had been formed in the tissue during muscular work.

Since then, however, F. S. Lee, a scientist who has made a special study of the fatigue problem, has succeeded in proving that the juice from thoroughly rested muscle tissue produced the same effect as that obtained from fatigued muscles, when injected into the muscle tissue of animals at rest. The presence of a specific toxin in fatigued muscle is therefore experimentally still unproved.

Some Small Inventions

Paste Tube with Rubber Tip Seals Itself after Use

A COLLAPSIBLE metallic tube with an elongated nozzle of resilient rubber containing a self-sealing opening, forms a new and convenient sort of container for paste.

The rubber nozzle is slit and pressure on the tube forces the paste through a recess and the opening. The neck is adapted to fit snugly within the recess and only as much paste as is squeezed from the tube is forced into the nozzle. As soon as the paste in the recess is emitted, the rubber contracts, automatically sealing the tube.

X-Ray Photographs of Hand Sent by Telephone

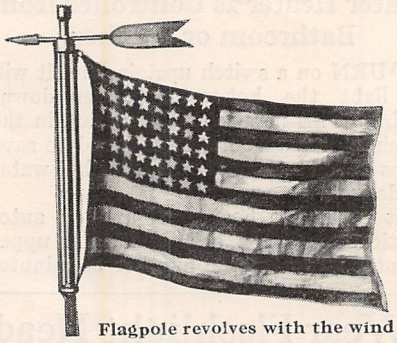
RECENT successes in telephoning X-ray photographs point to new marvels in treating disease. The first telephoned negative, showing the bone structure of a hand, was sent from New York to Chicago in seven minutes.

The details of the picture were reproduced clearly so that an accurate examination could be made.

Flag Flies Straight in Wind on Revolving Pole

TO KEEP a flag flying straight in the breeze and prevent it from whipping around the pole, a flag-staff attachment has been invented by William M. Post of Hood River, Oregon. This attachment is in the form of a corrugated tube that revolves with the wind, and so the flag always flies out from the pole, no matter from what quarter the wind comes.

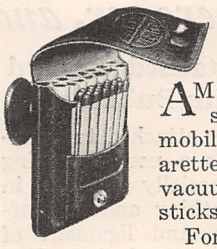
This ingenious invention may be attached to either wood or iron flag poles. It is ball bearing and will revolve 360 degrees (in a complete circle).



Flagpole revolves with the wind

Seeds Planted by Airplane

PLANTING forest-tree seeds from an airplane is the latest innovation in the reforestation of the Northwest. A large corporation holding several million acres of forest land arranged for an airplane capable of carrying two men and an extra load of cargo. While one man drove the plane, the other tossed out the valuable seed. More than 70 pounds of seed were scattered in a day by this twentieth-century method.



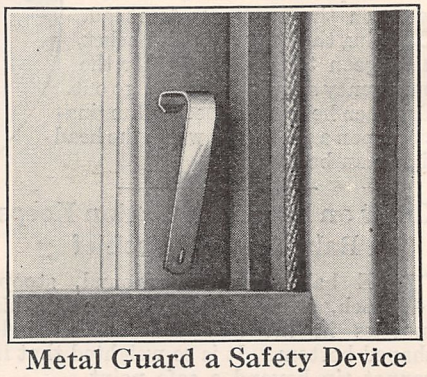
Cigarette Case for Motorists

AMONG the new accessories for the automobile is a pigskin cigarette case fitted with a vacuum-cup fastener that sticks to any flat surface.

For the motorists who like to have their cigarettes within easy reach, this cigarette case with its vacuum-cup fastener will be found very convenient, for it may be placed on the windshield or on any smooth, hard surface. The vacuum-cup fastener is unobtrusive and the case may be carried comfortably in the pocket. It is fitted with two compartments, one for cigarettes and a smaller one for matches, which provides, also, a match scratcher.

New Eccentric Tap Cuts Clean Threads Quickly

TO SPEED up the work of cutting threads in holes, a German manufacturer has designed a tap that has its teeth arranged eccentrically. This is claimed to cut easier and make a cleaner thread than an ordinary tap for the reason that the cutting edges are formed of teeth of various depths. A narrow cutting tooth first makes a preliminary channel; then a broader tooth, following accurately in its tracks, shears out a little metal on both sides. The next tooth broadens and smooths out the grooves, and the action continues in the same way until the thread is finished cleanly and accurately.



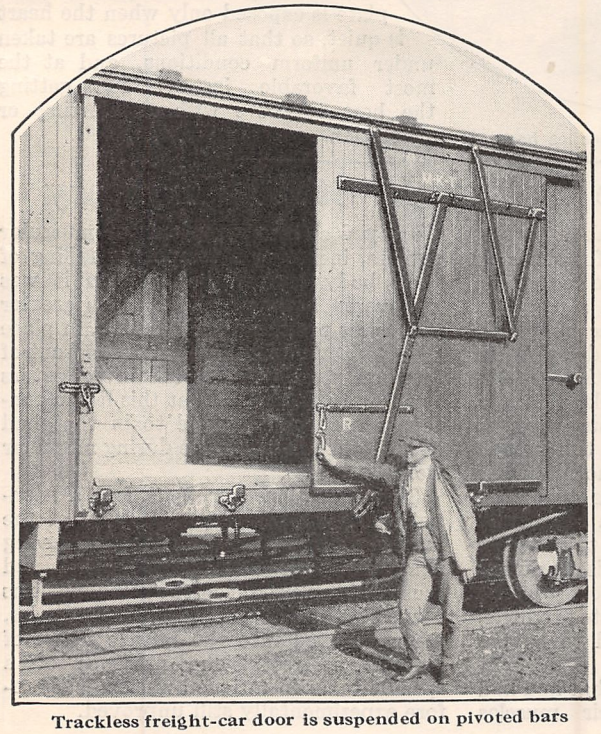
Metal Guard a Safety Device for Doors and Windows

PLACED on the floor in front of a door, this simple device will hold the door in place. It also will hold windows without weights in position. Since a window cannot be opened farther than the position of the metal guard, it serves also as a protection against thieves.

A New Kind of Potato

AGRICULTURAL explorers recently brought from the high Andes of Colombia and Peru rare varieties of potatoes said to have a flesh as yellow as butter and a delicious nutty flavor. United States experts are crossing the new potato with the common American "spud" to produce new forms of exceptional quality.

Trackless Freight-Car Door Will Not Stick



Trackless freight-car door is suspended on pivoted bars

WHEN a freight-car door sticks, time is lost and the door is battered and splintered from the endeavors made to open it with a crowbar. A new trackless hanger, introduced on several railroads recently, enables the doors to be opened, it is claimed, with a push of one hand.

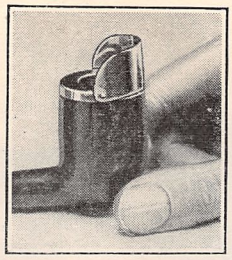
Departing from the general method of having the doors slide on a track, like a barn door, the door is suspended on metal pivot bars, and swings back and forth on them.

Pilfering of the cars is made more difficult, since the bottom of the door cannot be pried loose and swung outward. Only by breaking the seal is it possible for the door to be opened.

Guides serve to hold the door close against the car. A long bar with Y slot counteracts any tendency toward sagging.

with Large Usefulness

Windshield for Pipe



A WIND-SHIELD on a pipe prevents ashes and sparks from being blown into the smoker's eyes. It is made of nickel-plated brass and is fastened to the bowl of the pipe so that it may be turned down when it is not needed. In this position it looks like trimming on the bowl.

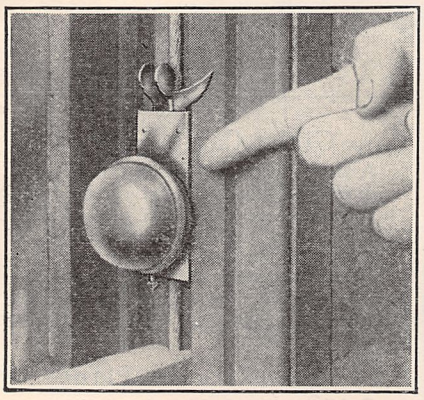
The pipe with this unique equipment is made of Italian briar and fitted with a hard rubber push-bit.

Flying Ambulance to Carry Hospital Patients

PATIENTS from neighboring states and from ships at sea will be carried to a hospital in New York City, now under construction, in airplane ambulances. The roof of the Columbia University Presbyterian Hospital Medical Center will be a huge landing-field, while flying boats will land in the river in front of the building.

If planes are developed to the point of practical, vertical flight a four-acre court in the middle of the hospital grounds may be used also for landing.

A nurse and doctor will be sent out in each airplane responding to call.



New Window Lock Is also Lively Burglar Alarm

FRIGHTENING the burglar and awakening the household, a new burglar alarm goes off when either the upper or lower window sash is moved. No tools are necessary for putting the device on a window. It fits over the window cord and prongs stick into the edge of the casement and upper sash.

The plunger just clears the top of the lower sash, which, when raised, sets the shrill alarm ringing.

The alarm is wound by turning the bell to the right.

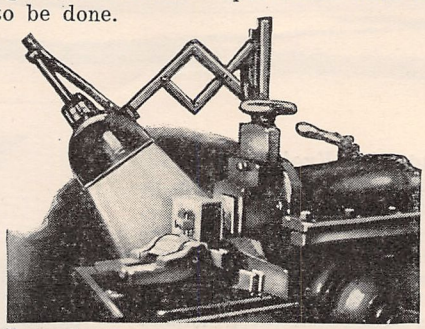
A Message from a Reader

I ALWAYS have had a leaning toward new inventions, and your magazine supplies exactly what I hunger for.—W. W., Reidsville, W. Va.

Extension Bracket Lamp Used for Inspecting Machinery

TO LIGHT up parts of machinery in the dark or shadow, a collapsible extension bracket for electric lamps is being introduced from abroad. For reading scales and when making fine adjustments, it is especially useful.

The device is similar to that used for extensible telephones. The light with its strong reflector can be moved to any angle at the end of the bracket, and the light directed to the spot where work is to be done.



Extension lamp used among machine parts

Secret Signals Are Sent by Invisible Rays

INVISIBLE light is opening up a new method for sending secret signals in warfare, according to Dr. Robert W. Wood, professor of Experimental Physics at Johns Hopkins University. Flash signals, he says, are invisible to all but the receiver of the message, and can be sent in full sunlight for a distance of from five to eight miles.

Infra-red rays, too long to be seen, cause certain dyes and pigments to become more luminous. The receiver of the message is equipped with a tinted shade for his field glasses, similar in color to the shade used in the signal lamp.

Flashlight that Clips on Belt Is Useful for Repair Jobs

A NEW flashlight with lens on the side and equipped with a steel clip by which the flash may be attached to the clothing or belt of a workman, leaves both his hands free for work at night or in places that are not supplied with ordinary lighting facilities.

It is designed particularly for repair and maintenance gangs, though many others will find it useful, such as householders and the lone motorist with engine trouble or a puncture on some unlighted country road at night.

Corns Removed by X-Rays

SCIENCE is coming to the relief of the man with corns. It is claimed that with a single large dose of X-rays, a large corn can be removed in one piece with no vestige remaining, and leaving a smooth healthy skin.

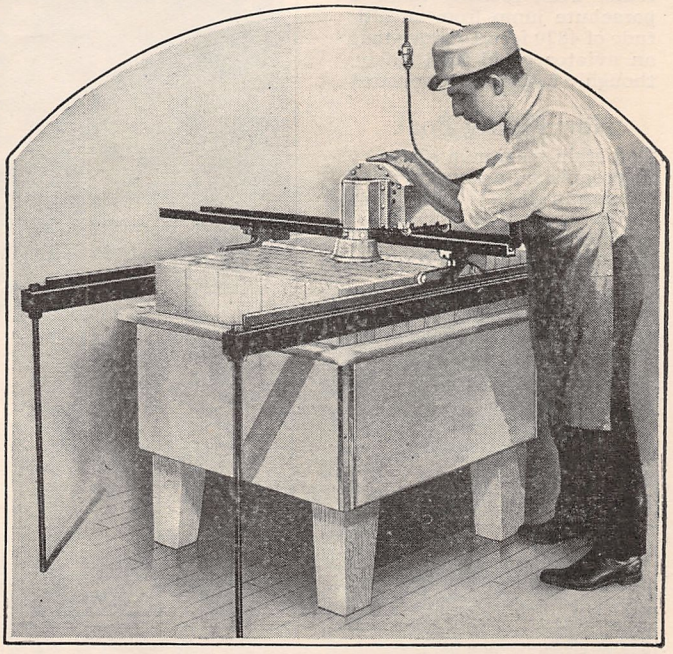
Some of the sufferers experience no unusual sensation after the treatment, while others complain of pain lasting from three days to a week. The pain can be eliminated, it is said, by dividing the dose into weekly treatments.

Meat Blocks Cleaned by Electrical Device

WITH this new portable electric surfacing machine, it will not be necessary to remove meat blocks from the butcher's shop when they need leveling or cleaning, it is claimed. An experienced workman it is said, can do the work in a few minutes, leaving the block level and cleaned of all grease and bloodstains from the meat.

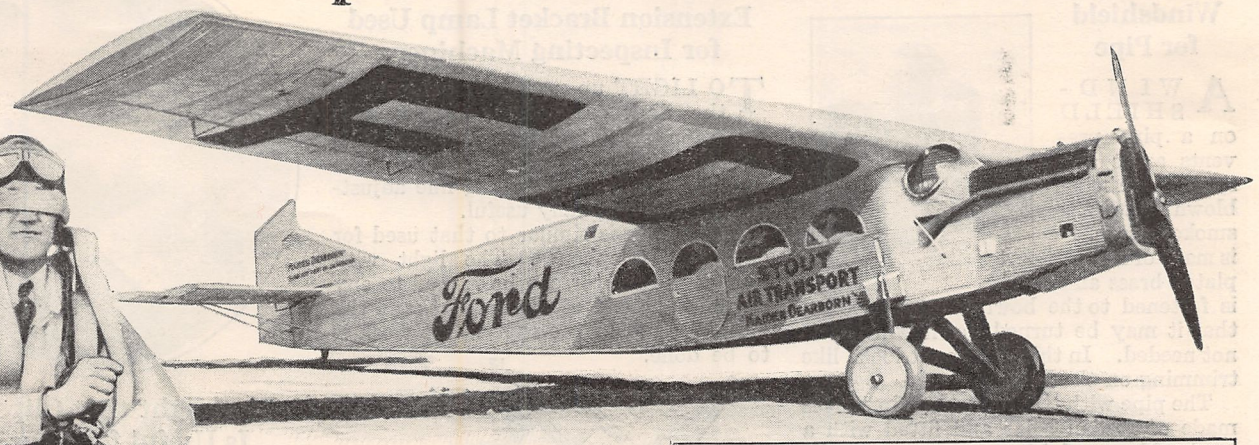
After setting the frame level over the block, a small motor with an accurately cut saw is started.

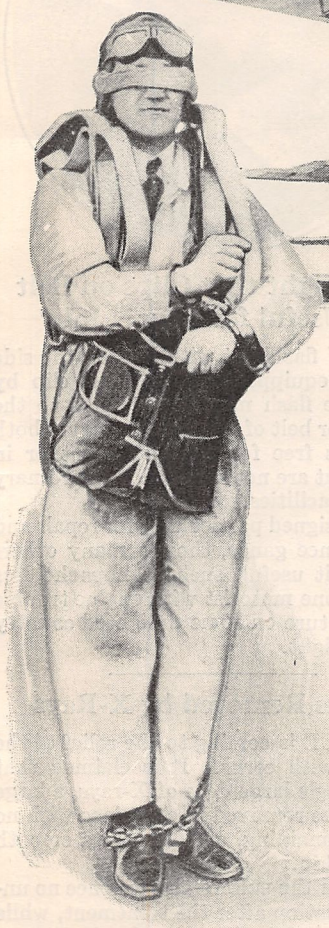
Connection for operating the machine is made with the electric-lighting circuit of the butcher's shop.



New apparatus for leveling and cleaning meat blocks

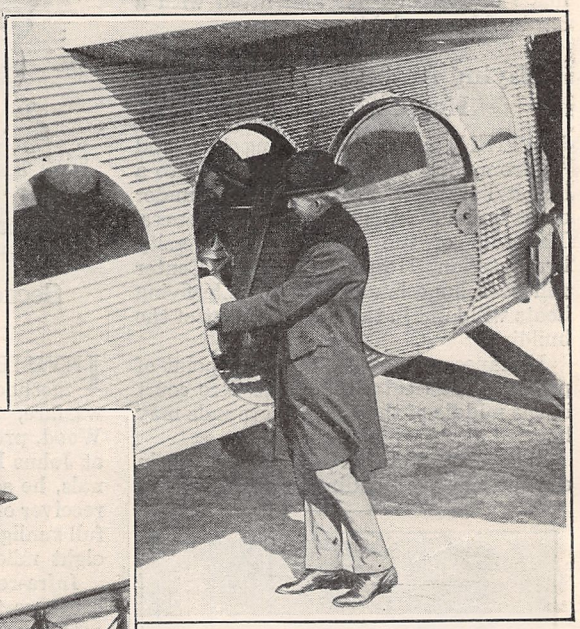
Spectacular Inventions





Huge Air Freighters

The recent successful round-trip flight of Henry Ford's *Maiden Dearborn* between Detroit and Chicago, marked the inauguration of the first strictly commercial air freight line in the United States. One thousand pounds of freight was carried each way, a distance of 285 miles, at an average speed of 100 miles an hour. The picture at the right shows Henry Ford placing part of the cargo in the airplane's fuselage



Leaps Blindfolded

Blindfolded, shackled, and handcuffed, Sergt. C. E. Conrad, of Kelly Field, San Antonio, Tex., recently made a parachute jump from an altitude of 4820 feet, to prove that an aviator could land safely, though helplessly wounded

New Flying Boat

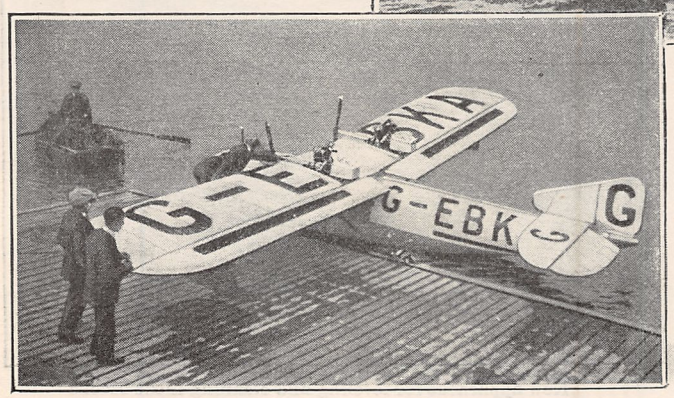
To obtain maximum efficiency in propulsion, a novel type of duralumin all-metal flying boat (below) with twin engines located in the wing centers, has been developed in England

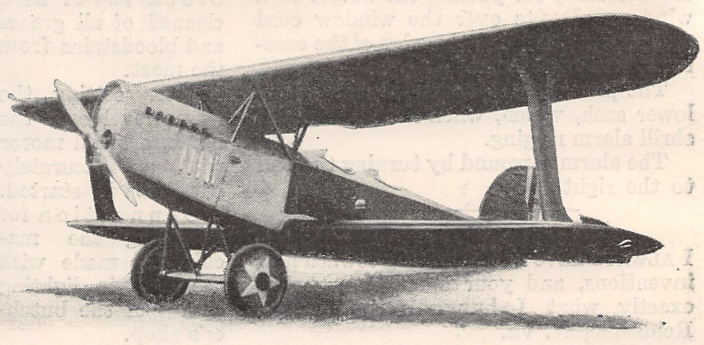
Glider Carries Bomb

A new motorless glider (at left) for discharging heavy bombs from a battle plane, recently was perfected by Brig.-Gen. William Mitchell, U. S. Army Air Service. Its purpose is to permit the pilot of a raiding bomber to release his cargo at a safe distance from enemy anti-aircraft gunfire

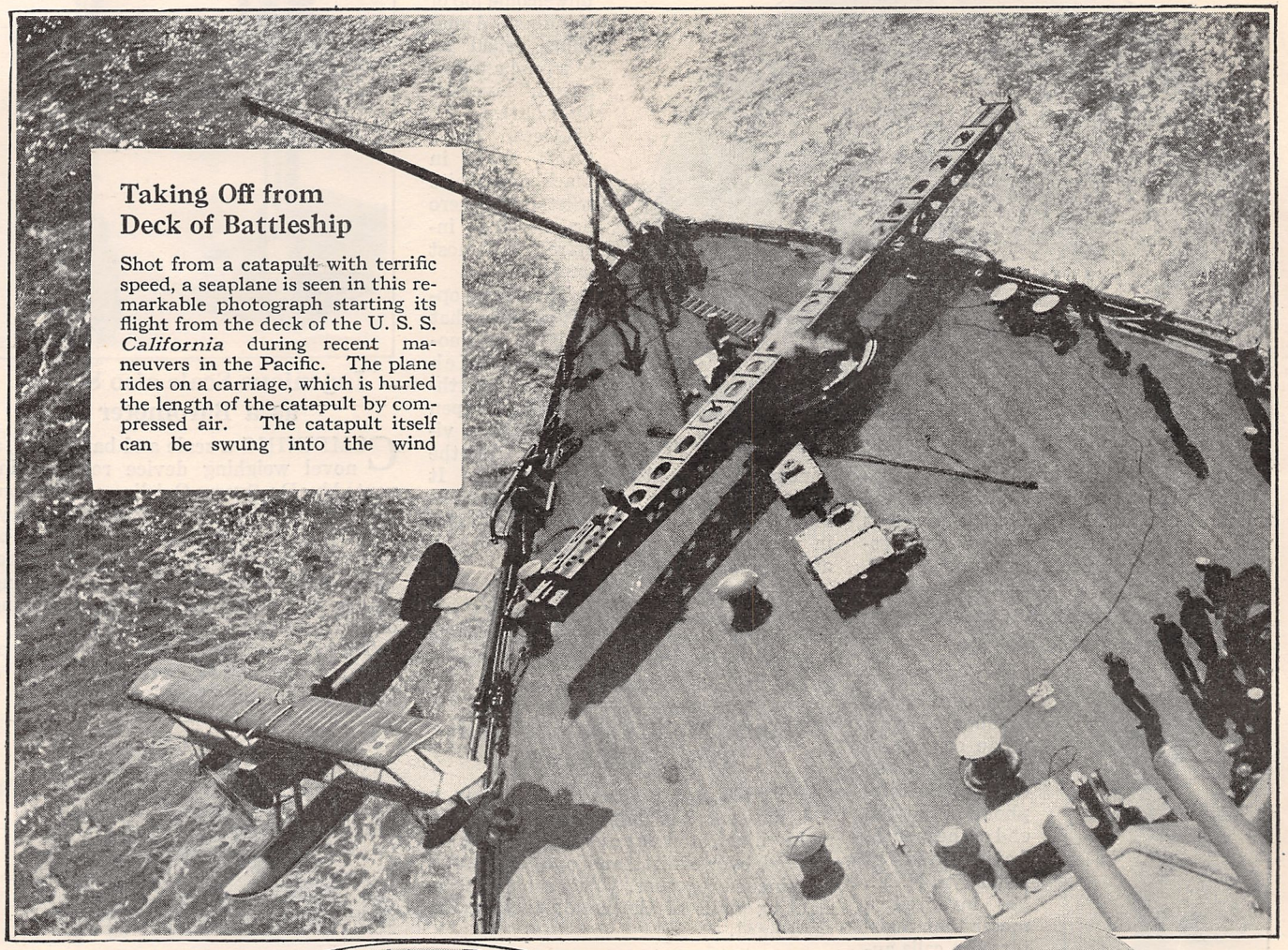
Knock-Down Plane

Quickly detachable parts of a new type of two-seater fighting airplane (below) are said to make it possible to assemble it complete, ready for flight, in less than an hour, and dissemble it in as brief a time as 20 minutes



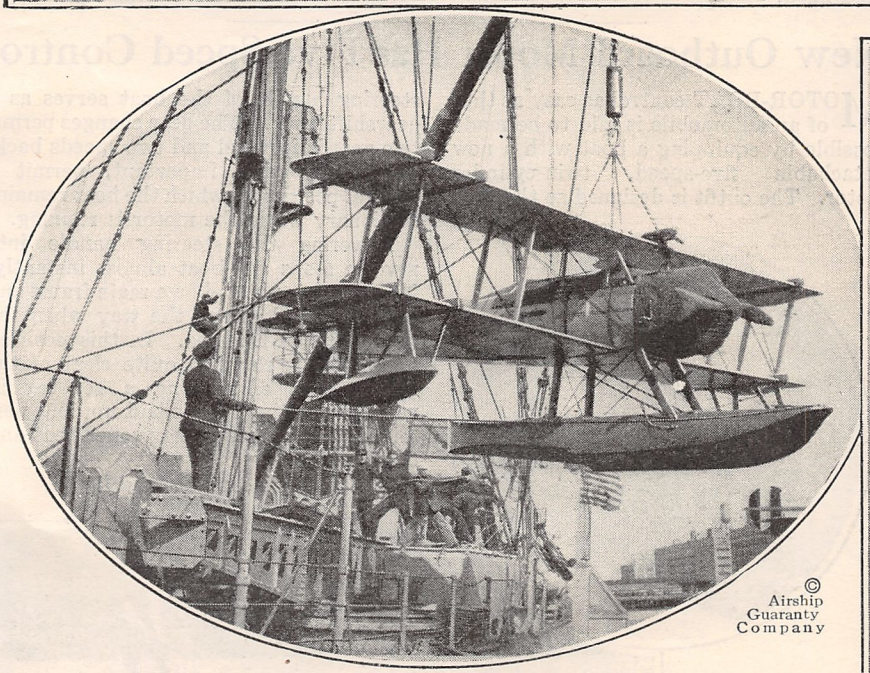


Mark Progress in Flight



Taking Off from Deck of Battleship

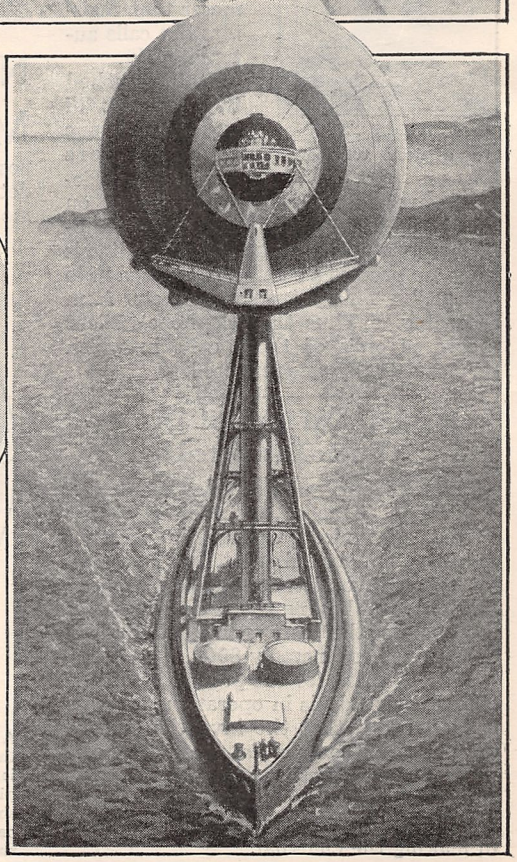
Shot from a catapult with terrific speed, a seaplane is seen in this remarkable photograph starting its flight from the deck of the U. S. S. *California* during recent maneuvers in the Pacific. The plane rides on a carriage, which is hurled the length of the catapult by compressed air. The catapult itself can be swung into the wind



© Airship Guaranty Company

The Air Scout Returns

Scout planes are becoming the eyes of modern navies. This picture shows the new scout cruiser *Memphis* taking aboard one of the two seaplanes with which she is equipped. The launching catapult is seen behind the plane



New Floating Mooring-Mast

The latest design in airship mooring-masts (right), developed in England, has two swinging horizontal arms that embrace the nose of the moored ship, and also serve as passage-ways for the landing and discharge of passengers

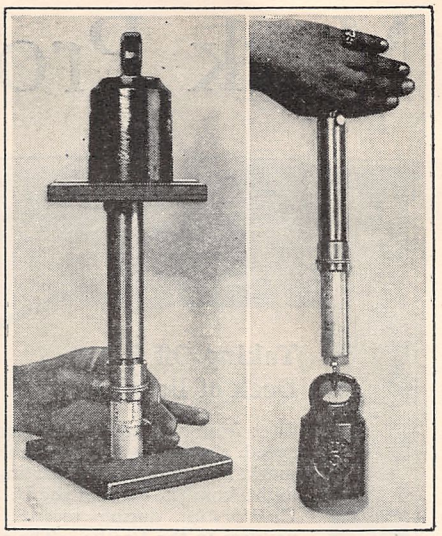
Applause Recording Machine Judges Actors

On a vibrating drum, a pen records concussions caused by handclaps

Stage managers no longer need to take the unwelcome job of deciding. A machine called an "applausograph," invented by Charles Lick of Ocean Park, Calif., shows in black and white whether the hero or heroine inspired the most applause.

The device operates somewhat like the seismograph, which measures earthquakes. A pen records on a vibrating drum the concussions caused by handclapping. It will not register yelling or whistling. The invention is expected to be of great value in vaudeville tryouts, dancing contests, and similar contests.

WHICH of the actors in the show was the most popular? Which received the most applause? Behind the scenes as well as in front, these are always questions that give rise to discussion.

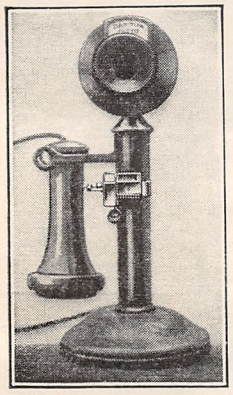


Ingenious Scale also Serves as a Barometer

COMBINING a scale and barometer, a novel weighing device recently invented by Dr. Sverre Quisling of Madison, Wis., is said to possess unusual accuracy, since it is adjustable to variations of temperature and barometric pressure. Two illustrations show how the weighing device may be used either as a hanging or platform scale.

The scale consists of two sealed tubes of different diameters, one acting as a piston within the other.

Telephone Calls Recorded by Automatic Device



The recorder attached to a desk telephone

TO KEEP a record of the number of calls made on a telephone, and so check up the telephone bill at the end of the month, Louis Fried, of Brooklyn, N. Y., has invented a meter that registers the calls automatically.

It is attached to the neck of any desk phone and registers when the telephone receiver has been put back on the hook after each call. If the subscriber gets a wrong number or the line is busy, he presses a small dial marked "No charge." This prevents the meter from recording. Thus the telephone's silent record is only of those calls in which service actually was rendered.

Economical New Charcoal Fuel Discovered

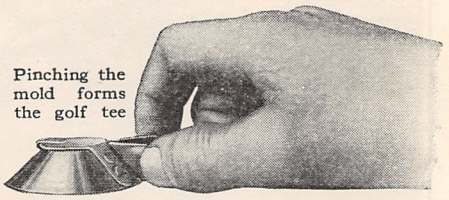
AFTER four years of experiment, Dr. Hugo Strache, a professor of the Vienna Technical College in Austria, recently announced that he had perfected an invention for making a cheap new charcoal having the same number of calories as the best grade of English anthracite coal, namely 8000.

A small plant for the production of the charcoal already is in operation, proving, it is claimed, that the invention can be developed for commercial uses. The cost of production is said to be low, owing to the valuable coal tar by products. Wood, wood shavings, and waste can be utilized in making the charcoal.

THE developed waterpower of the world has increased from 23,000,000 horsepower in 1920 to 29,000,000 horsepower in 1923, statistics show.

Handy Mold Fashions Golf Tees from Sand

A FIRM golf tee can be made in a moment, it is claimed, with the metal mold illustrated at the right. It is pressed over moist sand and two levers are pinched together. This contracts the slanting walls of the mold, packing the sand hard.



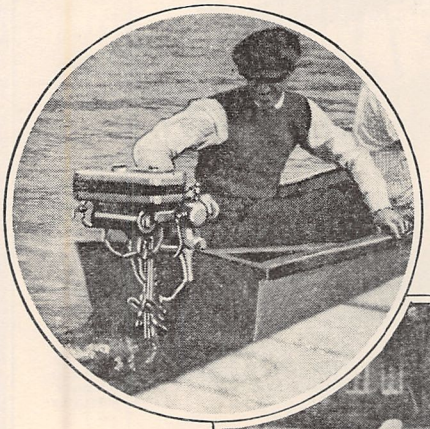
Pinching the mold forms the golf tee

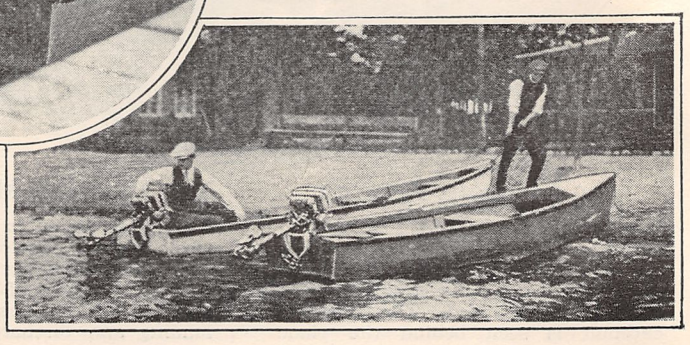
New Outboard Motor Has Five-Speed Control

MOTOR-BOAT control as easy as that of an automobile is said to be made possible by equipping a boat with a new detachable five-speed, twin-cylinder motor. The outfit is designed so that the steering handle of the boat serves as a gearshift lever. The gear changes permit two speeds forward and two speeds backward and, most important, permit a neutral position in which the boat remains stationary while the motor is running.

Lowering the steering handle into reverse stops the boat almost instantly. The motor is pivoted on a main frame and may be tilted out of the way when the boat is to be beached. In this position the motor is elevated quite clear of the water, thus eliminating a soaking in water while the boat is laid up, and permitting inspection of the propeller at any time.

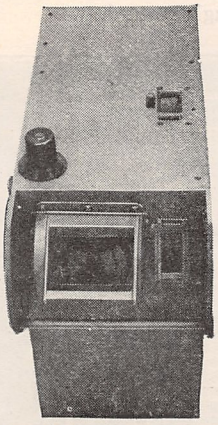
The motor is compact and light.





A close-up view of the outboard motor is shown above. The picture at the right shows how the motor can be tilted when the boat is beached

Airships Now Employ the First Camera Sextant



Showing camera with level set in the top surface

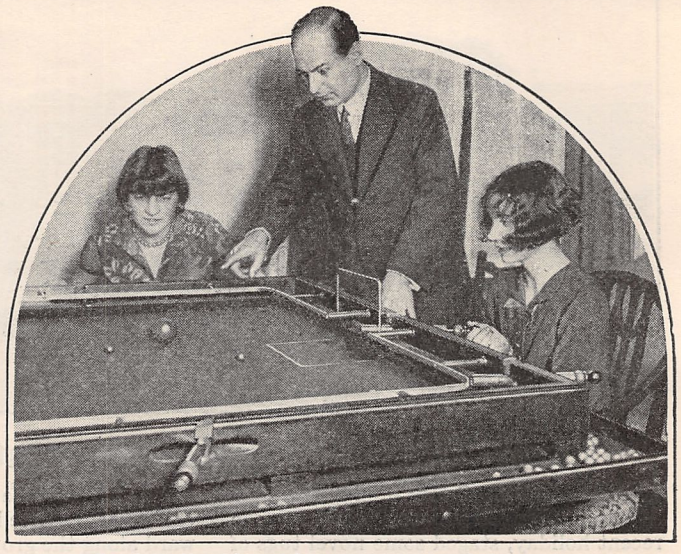
DUE to the large drift involved in airship travel, it is necessary constantly to make celestial observations. The old fashioned sextant used by surface ships depended on utilizing a visible horizon, thus eliminating sights during the night and whenever the horizon was obscured in the daytime.

The camera sextant is for the purpose of taking an accurate sight while in the air, without making use of a horizon.

This instrument consists essentially of a camera for photographing the heavenly bodies and contains also a spirit level that is photographed on the film. A base line is etched on the lens, and when the picture is developed, the altitude of the body above this base line is measured and a correction applied for the amount the bubble was off center.

A sight of the sun can be taken with this camera sextant to an accuracy of 1/250 of a second. The field of this camera covers about 20 degrees in altitude.

Battle Ball Is an Exciting New Table Game



Battle-ball table, with guns and one of the goals

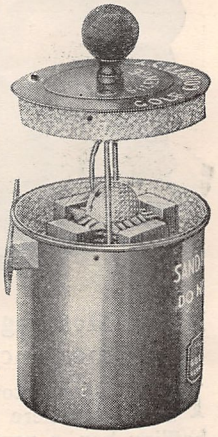
"BATTLE Ball," a new game invented in Austria and popular in Europe, now has crossed the ocean and is attracting attention in America. More than 500 clubs have been formed abroad to play the game and many tournaments are played in the larger cities.

The game is played on a table about the size of a small billiard table. Around the raised edges are small guns through which the players shoot little steel balls at a larger ball in the middle of the table.

The shooters take sides and score by forcing the ball into the opposing team's goal pocket at the opposite end of the table. It takes a degree of practice and skill to hit the ball, which is smaller than a baseball.

This game is not only entertaining, but it trains the eye to skilful marksmanship.

Latest Golf-Ball Cleaner Uses No Abrasive Substance

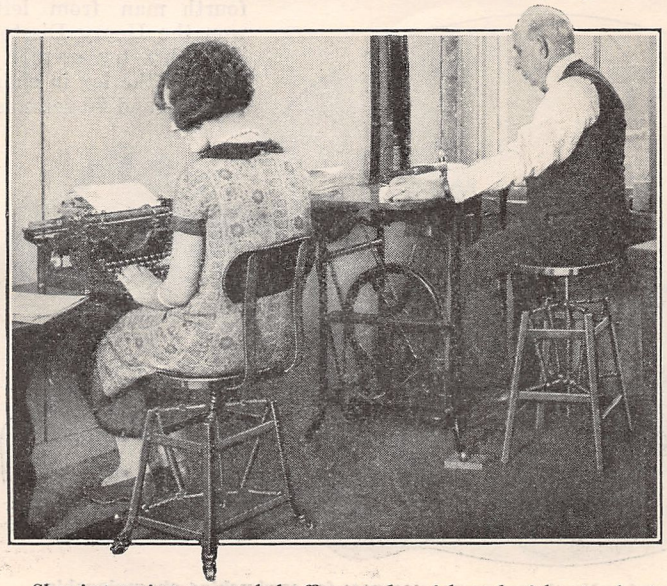


THE use of sand in cleaning golf balls is unnecessary in this newly designed golf-ball cleaner. A plunger pushes the ball up and down in a container between four brushes shaped like ordinary scrub brushes, the ball revolving at each plunge. These remove dirt from the ball without the wearing effect of sand, and thus preserve longer the bright finish and the life of the ball.

Less Fatigue Felt on Spring-Suspended Stool

AN OFFICE chair with full spring suspension, which, its manufacturers claim, will obviate much fatigue for the worker who uses it, has just been put on the market.

The stool is of steel construction and has 12 springs, horizontal and vertical. The elasticity of the springs enables the user of the stool to maintain proper posture, and the resiliency of the springs relieves the worker of the body fatigue that he otherwise would feel from sitting for hours at a time in one position on an ordinary rigid chair.



Showing spring-suspended office stools, with and without a back

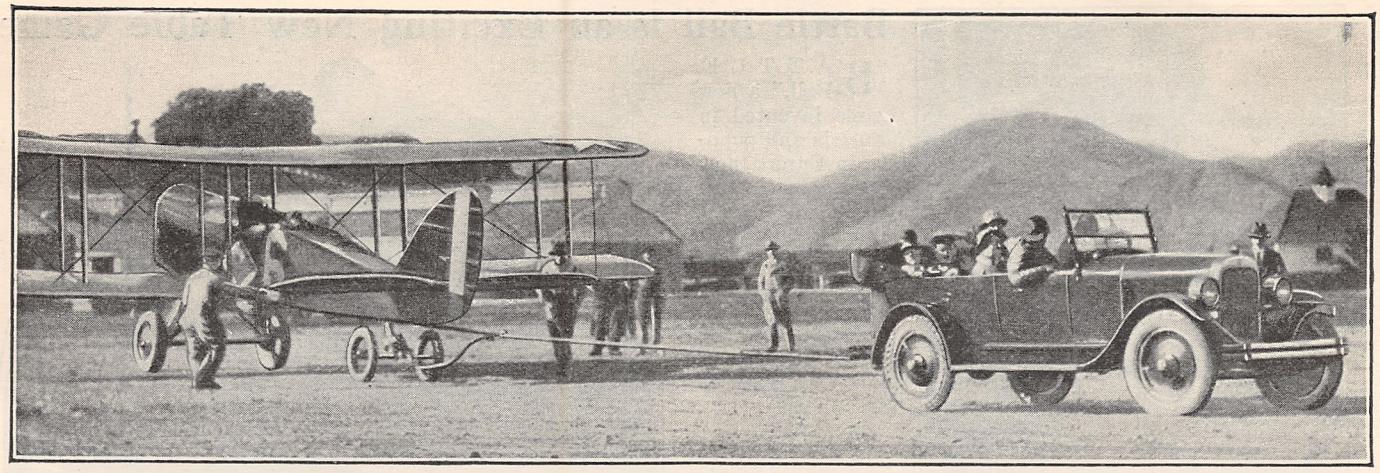
GREATER comfort in shoes may result from experiments recently described by George O. Mines of Milwaukee, Wis., to the American Chemical Society recently. He pointed out that the ability of leather to pass off perspiration may determine a shoe's comfort, and gave results of measurement of the evaporation of water through leather. Leather that absorbs moisture easily from the inside may show great resistance to wetting from the outside.

Stainless Silver Now Is the Aim of Metallurgists

EVER since stainless steel became an accomplished fact, metallurgists have been experimenting to achieve a stainless silver. According to Dr. H. W. Gillett, metallurgist of the Bureau of Standards, his department and the Bureau of Mines are working together in research and experiment on the problem and hope by the autumn to have definite results to lay before the public.

A British silver-manufacturing company already claims to have developed a tarnish-resisting silver. The material, which is 92½ per cent silver alloy, has been put to practical test by the manufacture of articles from it. The new alloy is said to stand the heat necessary for soldering.

Housewives the world over will welcome a commercially successful solution of the problem, as it will lessen considerably the labor attendant on keeping the silver in good condition.



Novel Tug of War Demonstrates Pulling Power of the Airplane

SOLDIERS at Crissy Field, the Presidio, San Francisco, celebrating a recent holiday, staged some novel tugs of war. In one of these the rear of an automobile carrying six passengers was attached by a cable to the tail of the airplane. When the engines of both machines were started, the plane moved forward along the ground, dragging the auto behind it. The photograph shows the contestants at the start of the tug in which the plane was victor.

The event offered a striking demonstration of the tremendous efficiency of the airplane propeller which, pushing only against air, is able to develop greater tractive power than rubber-tired wheels pushing against rough ground.

Bank Messenger's Bag Carries an Emergency Smoke Trail

POLICE inspectors of New York City are seen here inspecting a bandit-baffling box, a new device to impede a bandit from escaping after holding up a bank messenger.

Sprinkled in the bottom of the bank's box or bag in which the money is carried, there is a small quantity of powder. When held up by a bandit, the carrier of the box presses a device and sets off the powder, which, it is claimed smokes for 12 minutes.

The bandit, running through the crowds with the box, is hindered by the clouds of smoke, and his trail, so plainly marked, aids the police in locating and catching him.

600 Ways to Curl Hair

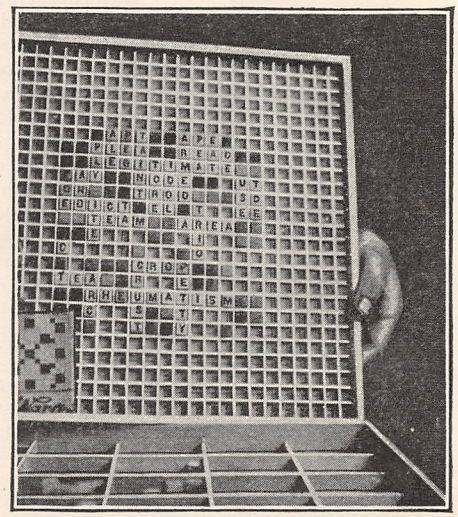
SIX hundred patents for new devices to meet the age-old desire of women for curly hair have been issued by the U. S. Patent Office. These devices include methods of waving hair by means of hot air and steam, by ironing, by combs and curlers, and by permanent-waving machines.

The first American patent for curling hair was issued in 1857 to a man named Lewis, who perfected an iron heated by plunging it in hot water.

Type Case and Form Aid the Cross-Word-Puzzle Fan

TO MAKE easier the solving or constructing of a cross-word puzzle and to avoid erasures, ar ingeniously designed movable letter puzzle "word maker" recently has been invented. It consists of a tray of tiny wooden cubes, each one marked by a letter of the alphabet or a black face to represent the spaces in the puzzle, and a wooden frame having 25 square spaces for each row of horizontal words and an equal number of spaces for the vertical words, making 625 spaces in which the lettered or blackened cubes may be inserted and taken out at will in making or solving a puzzle. Thus building or solving puzzles is given increased interest.

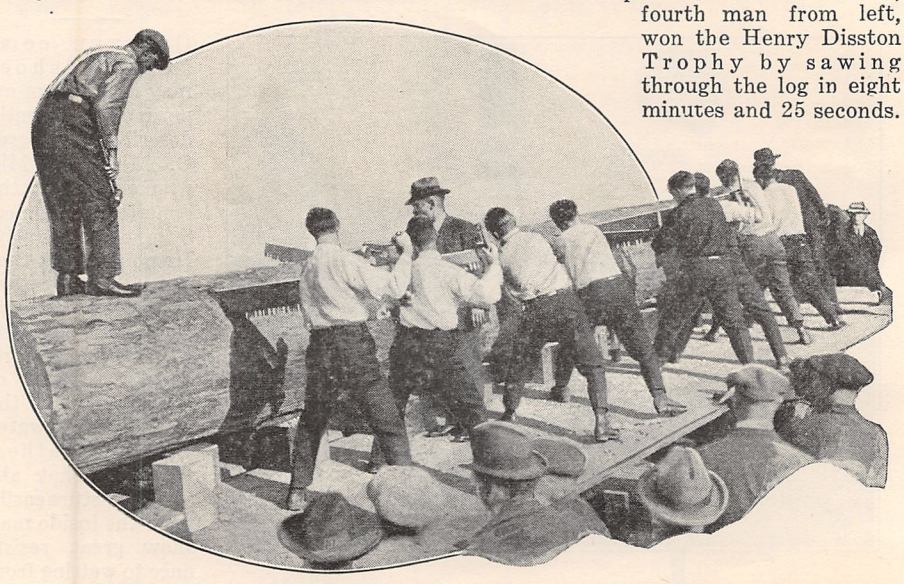
The tray in which the letters are kept is similar to a printer's type case.



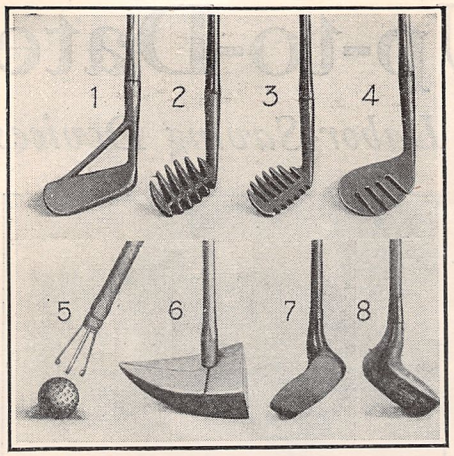
Partly constructed puzzle in new type case

Northwest Woodsmen in Log-Sawing Contest

EACH of nine lumber camps in Washington recently sent their fastest sawyer to contest for the state sawbucking championship at Seattle. Their saws bit through a 40-inch log with unbelievable speed. Emil Getchman, fourth man from left, won the Henry Disston Trophy by sawing through the log in eight minutes and 25 seconds.



Fastest sawyers in nine Northwest camps compete for sawbucking championship



Freak Golf Clubs Form an Interesting Collection

THE golf clubs shown above are from an English collection. A cross-beam putter (1) is a curiosity from America. Comb clubs (2, 3, 4) are for sandy courses. The putter with a spring claw (5) saves a stout person from stooping. A swan-necked driver (6) was designed to improve a club's balance. The mallet-shaped driver (7 and 8) was designed by the Marquis de Chasseloup Laubat, who exploited the theory that the flight of the clubhead through the air should be like a swallow's.

If you can hum, you can play

Mounted Policemen as Life-Savers in the West

RECENTLY, in San Francisco, a test was made to show how it was possible for a mounted officer to save a drowning person. Mabel Green, champion long-distance swimmer, volunteer victim, plunged into the sea, swam a bit off shore, then called for help. A squad of five policemen dashed into the ocean, and spurred their horses out through the breakers. Then one officer tossed a well aimed lariat in the direction of the swimmer and pulled her ashore.

No Tedious Practice Is Needed to Play This Instrument

HUM a tune and become a full-fledged member of a jazz band. This enticing suggestion that would make musicians of us all without long and tedious hours of practising comes with the invention of a new musical instrument recently introduced in England, and illustrated at the left.

It has two horns and humming into the mouthpiece starts the music. The effect is said to be that of a muffled trombone.

The World's Largest Book

A BOOK weighing 500 pounds, said to be the largest in the world, recently was displayed at the Southern Exposition held in New York City. It is entitled "The Story of the South in the Building of the Republic," and contains 2000 words. The leaves of this huge book are turned by electricity.

Bank Employees Shoot Dummy Bandit for Practice

BANDITS are wise to stay away from Chicago, for there bank employees are learning to shoot, and to shoot straight. Employees in a large number of the city's financial institutions are given a special course, training them how to handle a gun for protection in case of hold-ups.

To sharpen their eye and learn how to "get their man," a dummy bandit is used. Training with this novel target has found favor with the bank protective associations of the country.

Young German Invents Handy Water Skis

USING the same motions with which skiers glide over icy mountain slopes, Otto Saur, a young German inventor, crosses lakes and rivers. The water skis, shown in the picture at the right, which he perfected recently and demonstrated on a lake near Berlin, are the result of several years of study.

The skis are connected by braces that can be adjusted by thumbscrews to suit the skier's convenience. He propels himself with paddles.

How young Saur manipulates his water skis

Autos Outnumber Phones

THERE are now 2,000,000 more motor-cars than telephones in use in the United States, according to statistics recently announced by the Western Electric Company. A census by this company shows 17,740,236 motor-cars in operation, as compared with 15,369,454 telephones, or 100 motor-cars for every 86 telephones in the United States.

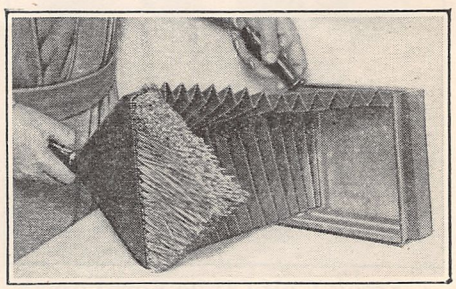
In France the proportion is even more startling. There the latest figures show 573,967 motor-cars in operation compared with 524,592 telephones, or 100 motor-cars to every 81 telephones.

What the Up-to-Date

She Looks for Labor-Saving Devices

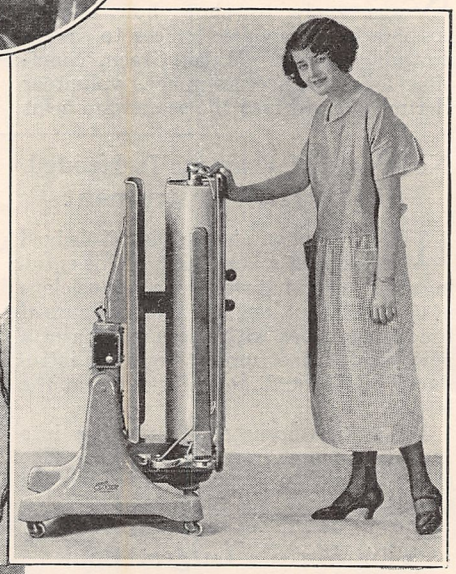
Ironer Takes Little Space

When the ironing is done, this compact ironing machine can be tipped over in an upright position, as shown below, and stored away. The ironing shoe is automatically opened and closed by motor, or may be opened by hand if preferred



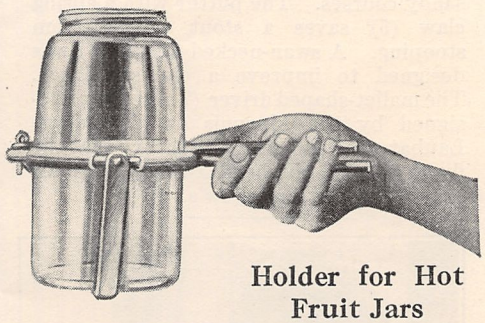
Dust-Catching Pan and Brush

A combined dustpan and brush prevent dust from flying while sweeping stairs. A shaped canvas frame is attached to pan



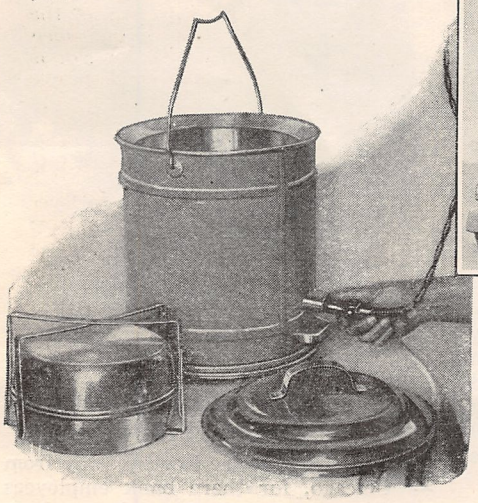
Automatic Ironer in Use

The ironer shown above is heated by electricity or gas. Shirts, waists, and similar articles are ironed at one end, which is open. The flat pieces simply are fed to the roller. A rack attached to the ironer at the right is handy for holding and airing the finished articles



Holder for Hot Fruit Jars

To prevent burns and cuts when canning is the purpose of this holder and wrench for fruit jars. It holds the jar firmly while being filled, and can be removed easily, after the jar lid is screwed on, simply by inverting fruit jar on the table



A Portable Electric Cooker

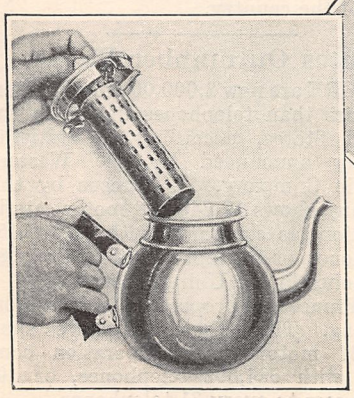
Because of its well insulated oven, it is claimed that this electric fireless cooker consumes very little current. It will bake, boil, roast, steam, stew, and fry sufficient food for six people. A combination of cooking vessels is provided with the useful cooker

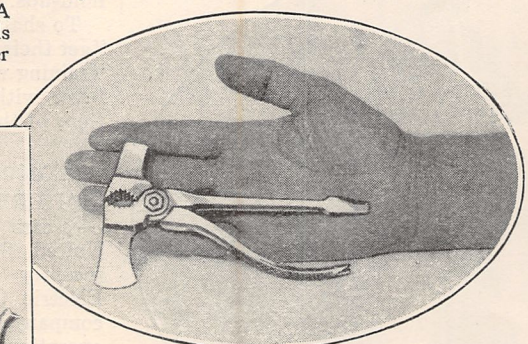
A Tool of 100 Uses

Though only five inches long, this handy little tool is a combined screwdriver, tack puller, pipe wrench, hammer, two kinds of wire cutter, and small hatchet. It is safe to say that the housewife will find a hundred uses for it and will always keep it near by

Ironing by Gasoline

This gasoline iron is heated by gasoline contained in the small tank at the front of the iron. The air in the fount is warmed by heat conduction, which creates sufficient pressure to heat the iron. One filling of the fount, it is claimed, will do an average family ironing. By means of a valve at the back of the iron, the heat can be regulated to any degree desired for light or heavy work



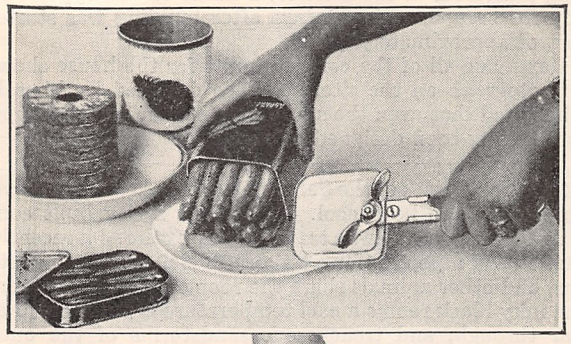


New Anti-Tannin Teapot

The teapot illustrated at the left contains two perforated cylinders. The tea is placed in the inner cylinder. When the tea is sufficiently infused, a slight turn of the lid closes the holes in the cylinders

Housewife Is Using

to Shorten Her Working Hours

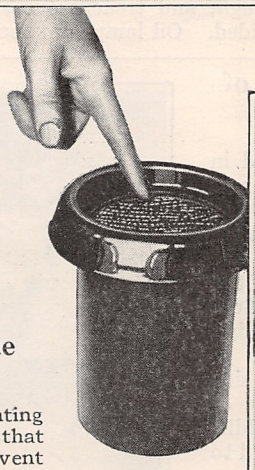


A Homemade Marcel Wave

The makers of the hair-waving device shown below claim that a perfect marcel wave can be attained in a few minutes. The appliance consists of six combs that set the waves, which afterward are held in by hairpins until the hair is dry

Two Tables in One

This demountable table-top has two sides—one of porcelain, the other of oak. When the housewife is preparing a meal, she may use the porcelain side of the table folded to half its size; but when mealtime comes, the opened oak side is used. It easily will seat eight people

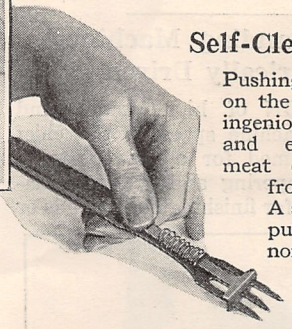


An Opener for Square Cans

It is claimed that this opener will cut cans with square or oval tops as easily as round ones. Near the cutting wheel is a smaller wheel. Both revolve, cutting just below the rim

Gas-Range Flue Catches Dust

The finger above is pointing at a gas-range flue that takes the place of a vent pipe and, it is claimed by the inventor, catches all the smoke, grease, and dirt that come from a gas oven when in use. The filter in the top, made of copper mesh, may be taken out and cleaned when necessary

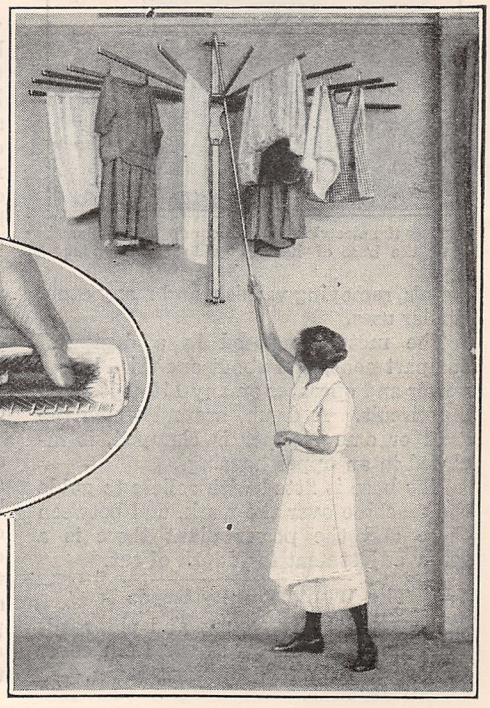


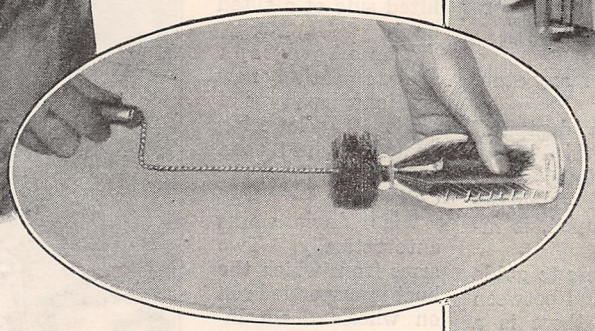
Self-Cleaning Fork

Pushing a little lever on the handle of this ingenious fork quickly and easily removes meat or other food from the prongs. A spring pulls the pusher back into normal position

An Elevating Clothes-Drier

An old friend with a new feature is this elevating clothes-drier pictured at the right, that will fit in any convenient corner and that will raise the clothes near to the ceiling, where they are out of the way. A central supporting rod is fastened to the wall



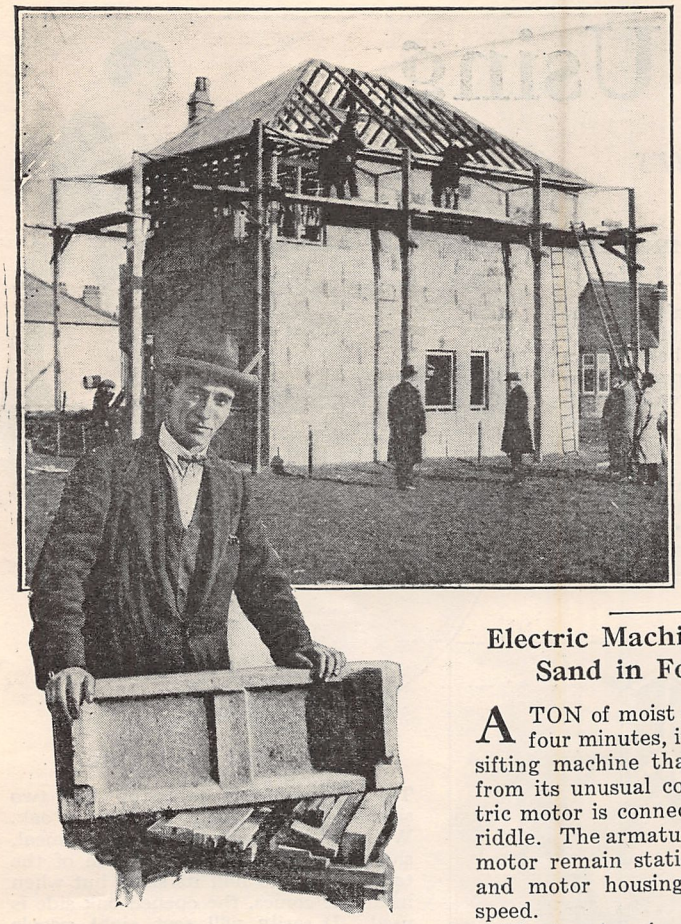


Don't Wait for Washday

Many a business woman will get a great deal of use from this handy little washer. The makers claim that it will wash dainty pieces of clothing and handkerchiefs in a few minutes. Its chief virtue, perhaps, lies in the fact that while the articles are being sloshed around in the suds, no water splashes the operator. The washer also is useful in a sickroom

New Bottle-Brush Handle

Nurses and mothers are probably the only ones who will recognize immediately the particular value of this latest bottle brush. A turn of the handle and the baby's bottle will be cleaned



The inventor with one of his new facing blocks. Above, a house under construction

Builds Novel Concrete Homes

A NOVEL experiment in house construction is being carried out by Walter Rex, of Whitley Bay, England, inventor of a new type of concrete block. The house is built of timber, faced with concrete units tied to the framework with lugs and galvanized nails. The exterior finally is rough cast.

Under mass-production methods, the inventor claims that, including plastering in the interior, a house of this type could be ready for occupancy in 28 days after building was started at a cost of approximately $1800.

Mr. Rex made all of the concrete units for the house shown in the photograph on the site, in molds designed by himself. It will be noted that even the scaffolding is of an unusual type, this, too, having been designed by the inventor.

ON THE burning wastes of the Sahara Desert one tribe of natives has found a way to keep cool. It lives in a city built completely underground. A Swiss traveler, who explored it recently, says that it has a population of about 30,000 and that goats, chickens, and other animals share the rooms with their owners.

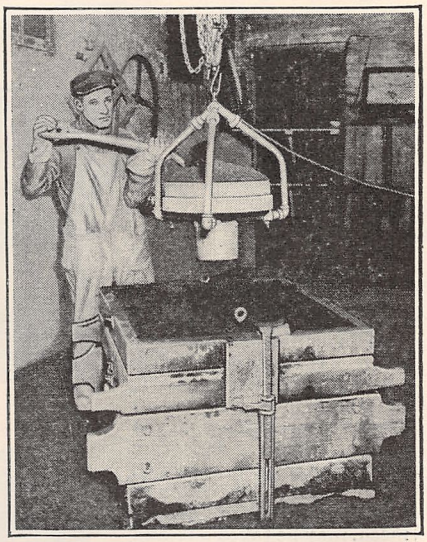
In the inky black rooms a cool temperature is maintained all the year through, and treacherous sandstorms of the outer world are avoided. Oil lamps are used for illumination.

Electric Machine Sifts Ton of Sand in Four Minutes

A TON of moist sand can be sifted in four minutes, it is claimed, by a new sifting machine that obtains its motion from its unusual construction. An electric motor is connected directly with the riddle. The armature and the shaft of the motor remain stationary while the field and motor housing revolve at a high speed.

The housing is weighted on one side so that as it revolves, an eccentric or circular motion is conveyed to the riddle. This rapid vibratory movement is said to insure a more thorough and faster screening or mixing of materials than former methods, where a stationary screen was used.

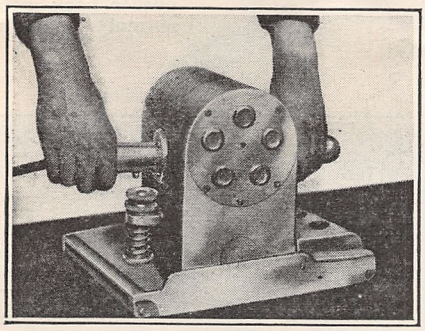
In straining or mixing liquids, a special attachment is used. Attached to the bottom of the lower receptacle is a spout for delivery of the material.



Sifting sand by electric motor. Armature and shaft remain stationary while housing revolves

Portable Sanding Machine Is Electrically Driven

PRODUCTION of high grade hand work at machine speed is the chief advantage claimed for a new portable electric sandpapering and grinding machine designed for finishing hard woods or metals, removing varnish, and many other similar uses.



How the electric sander is operated. Rollers at the base of it help guide the machine

The motor, inclosed in a dustproof compartment, is of about one-third horsepower and operates on any 110-volt lighting circuit. A drum, around which the sand or emery paper is clamped, is inclosed in an upper housing.

The base is fitted with rollers to guide the machine over the work, and between these and the power plant there is a screw adjustment for depth of cut.

The Whole Family Reads It

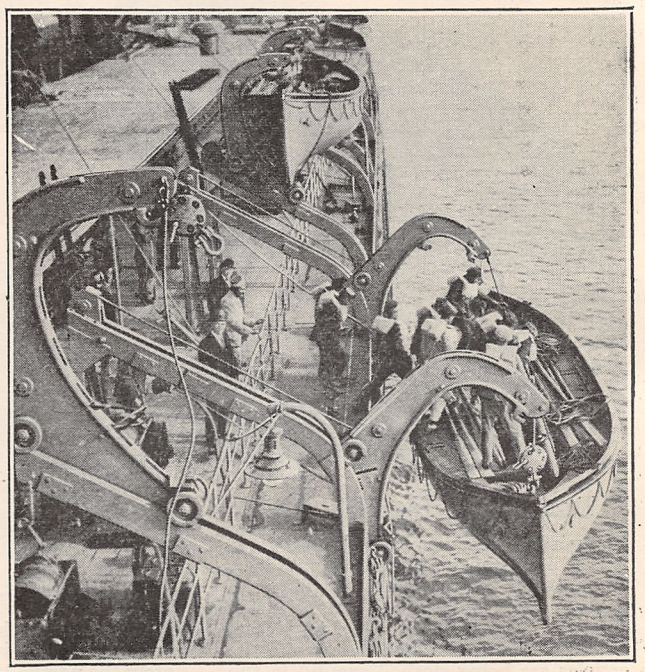
MY WHOLE family, young and old, reads POPULAR SCIENCE MONTHLY from cover to cover.—A. W. T., Preston, Minn.

Lifeboats Lowered from Ship Automatically

APPARATUS for lowering lifeboats in the quickest time possible has long held the attention of ship designers. Lowering the boats is a most difficult feat, especially from the lifted side of a tilted deck.

The photograph shows an entirely new and ingenious type of davit for lowering boats, installed on a new British liner, the *Cathay*.

This davit works automatically. Two arms from which the boat is suspended roll on wheels down inclined tracks fastened to the sides of the ship, and finally suspend the lifeboat well clear of the side of the vessel.



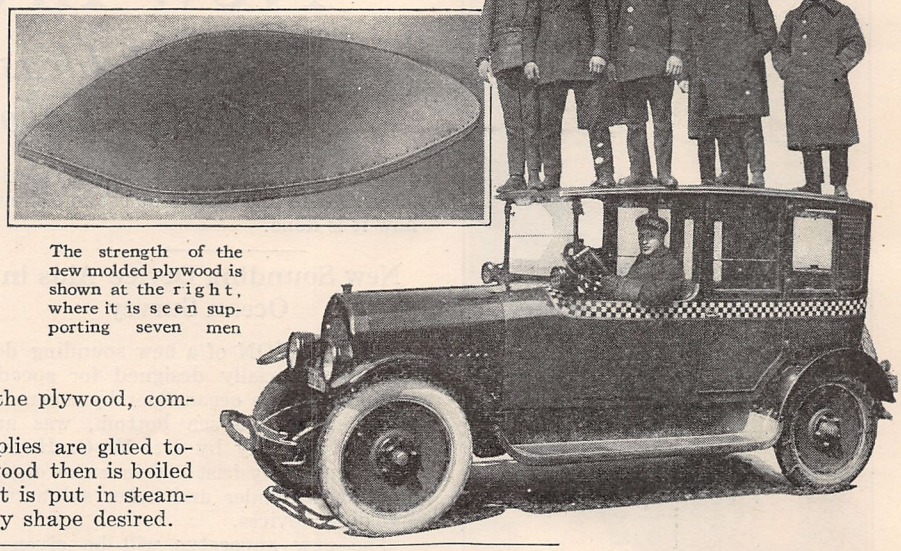
Lowering a lifeboat by means of the new automatic davit. Two mechanical arms holding the boat slide down inclined tracks

Waterproof Plywood Molded by New Process

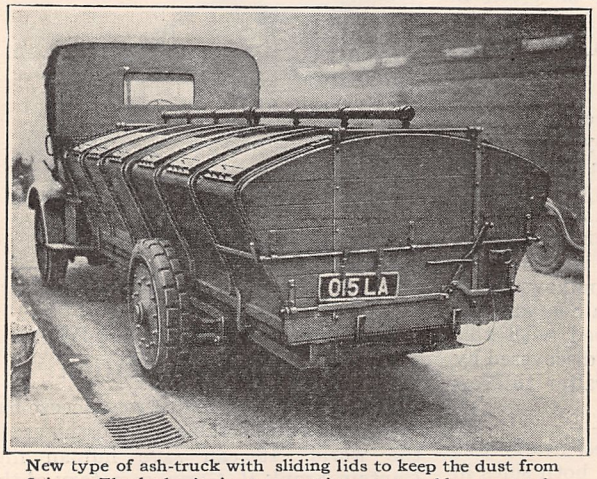
THROUGH a new method of molding waterproof plywood, wood may be shaped almost as easily as metal, it is claimed, and used in a wide variety of ways. For airplane fuselages, curved roofs of buses and street-cars that are subjected to severe weather changes for many years, the material is said to be especially valuable.

Plywood panels usually consist of three thin sheets of wood glued together, the grain of the center sheet crossing that of the outside sheets at right angles. This crossing prevents expansion and contraction with changing moisture conditions. While simple curved surfaces can be made successfully by gluing together pieces of the plywood, compound curvatures often result in splits.

In the recently developed method the plies are glued together with a new waterproof glue. The wood then is boiled or steamed until it is softened, after which it is put in steam-heated dies. These press the wood into any shape desired.



The strength of the new molded plywood is shown at the right, where it is seen supporting seven men



New type of ash-truck with sliding lids to keep the dust from flying. The body is in two sections, removable separately

Ash-Truck Made Dustless

DUST or ashes carried in open trucks often are distributed freely by the wind along the way. When the truck reaches its destination, only part of the load remains. The rest is spoiling the appearance of the streets.

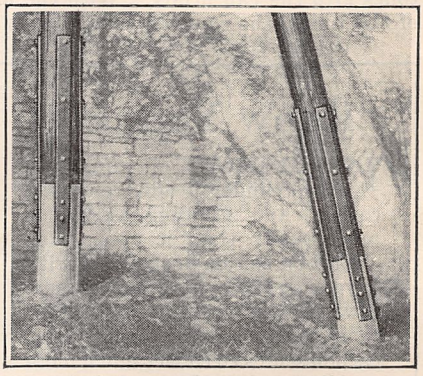
A new type of dustless ash-truck with sliding lids recently has been introduced for use by street-cleaning departments. The body is in two sections. Either can be lifted separately.

Concrete Bases Keep Phone Poles from Rotting

LOSS of poles through the rotting of their bases in the ground is a serious problem of telephone companies. France claims to have solved it by an ingenious method of mounting the poles on bases of concrete. This method is said to be inexpensive and to require little additional labor.

The pole fits on a base of concrete, held in position by four steel strips. This base is precast with bolts in the form. Holes are bored in the pole at the storage yards. On the spot where the pole is to be erected, it is bolted between the steel strips and thus attached to the concrete base. The assembled whole then is put up in the ordinary way.

A space is left between the pole and the concrete to allow for circulation of air and so avoid dry rot. Care is taken that the concrete protrudes above the ground at least a foot.



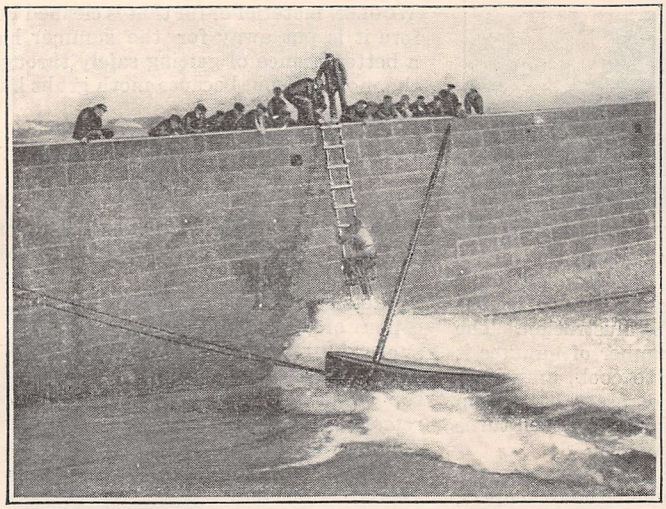
How the poles are bolted to concrete bases to prevent their rotting in the ground

Life-Saving Ladder Invented by a Pilot

GUILLAUME GUIVAR'CH, a pilot of the port in Audierne, in Brittany, France, recently invented a life-saving ladder for use along the high sea walls on that rough coast. Storms often dashed small boats against the walls and the unfortunate occupants, unable to reach the top of the wall, perished. For rescue work from boats and piers the ladder is said by those who have seen it in use to be equally effective.

The ladder is made of tarred rope with rungs of wood that have balls at each end that can be seized by a drowning person. It is fastened at the top of the wall. To the lower end of the ladder a cord carrying floats is attached. This may be grasped by a struggling person who is not able to reach the ladder by swimming.

Another cord, hanging from the top of the wall or pier, has a slip-knot noose that the drowning person can slip under his shoulders, provided he has strength enough to do it. With this in position, a rescuer on top of the sea wall can help.



Demonstrating the ingenious rope ladder in rescuing a man whose small boat has been disabled at the foot of a high seacoast wall

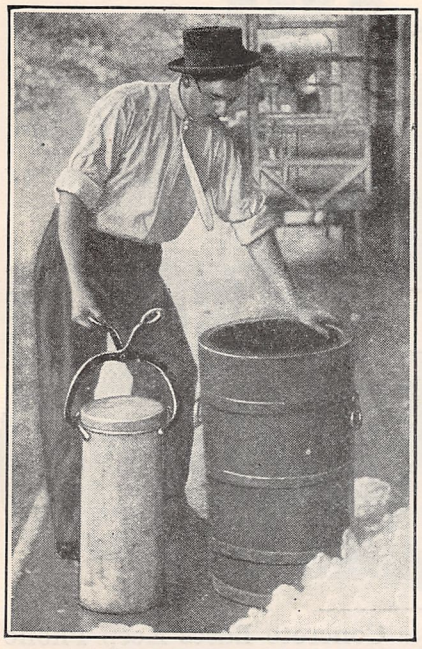
SUCCESSFUL tests of natural gas as a substitute for gasoline in automobiles are reported from Rome, Italy.

Electricity a Moth Killer

ONE of the newest uses for electricity on the farm comes from New Jersey, where a peach-grower recently discovered that a battery of electric lights, hung low over pans filled with kerosene, was an effective way to rid his orchards of the Oriental-moth pest. The lights, he says, lure the moths from the foliage. The moths fly for the lights and soon fall into the deadly kerosene pans.

New Inventions and

Practical Ideas You Can Use at Home
World's Laboratories—A Fascinating



Tongs Assist in Handling Ice-Cream Cans

HANDLING an ice-cream can, even in summer, is a cold job; fishing it out of salt water in a large freezer is a slippery one. An inventor has made the task of the packer and delivery man easier by making tongs fitted especially for this work.

Curved cross pieces on the ends of the tongs grip the can firmly. With the aid of the tongs, the rounded container, it is claimed, can be carried as easily as a cake of ice. The illustration at the left shows how it is done.

Know Your Car

IN THESE days of removable auto cylinder heads, removing carbon and grinding valves is much easier than it used to be.

Carbon can be burned out with oxygen so easily that most owners have the job done this way rather than with scraping tools. But carbon seems to collect much more rapidly in a cylinder head that has been burned out than in one where the carbon is removed by hand.

A good compromise, however, is to alternate, having the carbon burned out one time and scraped out the next.

To do a good job of carbon scraping and valve grinding:

1—Be sure to remove *all* the carbon so that the metal is smooth and bright.

2—Don't try to hurry the grinding. Use moderate pressure on the valves, turning them with a back-and-forth motion.

3—Be careful not to allow any of the grinding paste to fall down into the cylinders or valve-stem guides.

4—Be careful to use gasket shellac with a *new* gasket when replacing the cylinder head; also try all the cylinder-head bolts after the motor has been run a few miles.

New Sounding Device Aids in Ocean Survey

PERFECTION of a new sounding device especially designed for speedy mapping of the ocean floor by means of echoes from the sea bottom, was announced recently by Dr. H. C. Hayes, U. S. Navy physicist and inventor of the sonic depth-finder and other submarine signaling devices.

The new apparatus will be given a rigorous test on the U. S. S. *Dallas* within the next few weeks and is expected to displace the larger and more costly machines now in use.

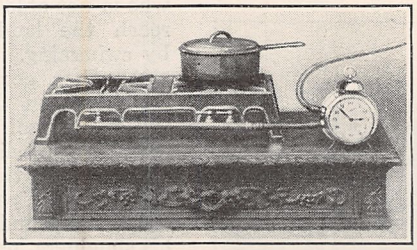
Surveys by means of the original sonic depth-finder were made by the battle fleet that was operating in the Pacific. These surveys are made in the ordinary course of the voyage and in the last year remarkable results have been obtained in many parts of the world.

For example, a hitherto unknown bank in the supposed deep China Sea was discovered by a ship equipped with this device. Another bank was discovered by a ship traveling from Gibraltar to New York.

TWENTY-SIX thousand lives, nearly five times the number killed on both sides in the battle of Gettysburg, were lost in traffic accidents during the last year. In addition, more than 700,000 persons were injured permanently from the same cause.

More than a third of the auto victims were children. Smashed automobiles and other property destroyed in traffic accidents amounted to the appalling sum of $1,000,000,000.

Clock Shuts Off the Gas when the Meal Is Cooked



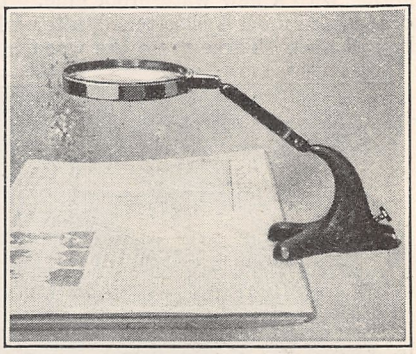
A MAGIC alarm-clock, on the job to keep the meat from burning while the housewife goes shopping or to the movies, is shown in the illustration. The clock is set for the number of minutes it should take the food to cook, and when those minutes have elapsed, the alarm goes off. The vibrations of the bell turns the gas off automatically.

This stay-at-home assistant was invented in France, where housekeepers, just as in America, dislike being tied down to the kitchen.

Adjustable Arm Supports New Magnifying Glass

A NEW type of adjustable reading-glass that can be supported on either a table or a chair recently has been perfected. A metal arm that holds the glass is fitted with universal joints, making it possible to swing the glass easily to any position desired.

A clamp is used for fastening the glass to the arm of a chair or the edge of a table.



An adjustable arm holds the glass

Red Pepper Found Useful to Prevent Asphyxiation

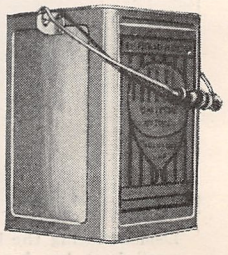
RED pepper that makes you sneeze has found a respectable and worthy use in the world. It can save human life. Captain Frank B. Gorin, secretary of the Chemical Warfare Association, recently disclosed this discovery.

A volatile oil is derived from the red pepper. This can be mixed with the illuminating gas that flows through your gas mains. Then if the flame should blow out, and gas escape into a room, any one breathing it is seized with such violent coughing and burning of the eyes that he has to run from the gas-laden atmosphere. Thus accidental asphyxiation is prevented.

WOOLEN material or fur that is cleaned before it is put away for the summer has a better chance of getting safely through the moth season, because moth grubs like soiled spots best.

Handy Buckets Easily Made from Tin Cans

LARGE, well made tin cans that come from the grocery store may be made into serviceable buckets by the addition of handles from worn-out buckets. After the top of the can is removed, ears for holding the handle are made of galvanized iron and riveted to the can as shown.



Useful Discoveries

—Valuable Contributions from the Test of Your Scientific Knowledge

Handled Holder for Blacking-Tin Prevents Soiled Fingers

BLACK hands as well as black shoes usually result when you try to polish your shoes at home. Holding the blacking-tin in the hand causes most of the smudges.

An ingenious and very simple device, made for the purpose of avoiding this, is the wooden holder illustrated. Any blacking-tin of ordinary size fits in the holder, which has a conveniently large handle. A wooden cover helps to keep the blacking from drying.

How blacking-tin sets in the holder

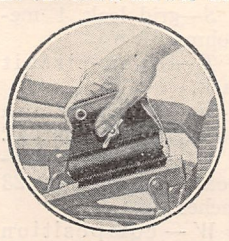
Chemistry Is Saving Millions in Tire Bills

CHEMICAL research is saving American motorists $50,000,000 a year in tire bills alone, according to a recent statement made by William G. Geer of Akron, Ohio, to the American Chemical Society. Much of this saving, he said, has resulted from the discovery and use of organic "acceleration" in the manufacture of tires, which permit them to be vulcanized in from one-third to one-fifth the time formerly required.

Other chemical research has added materially to the life of a tire. Twenty years ago the average life of a tire was only 2500 miles, whereas tires now are made that cover 15,000 and 20,000 miles before wearing out.

Simple Lawn-Mower Sharpener Is Adjusted Easily

TO SHARPEN lawn-mower blades, a simple hand tool has been invented, adjustable to all types and makes of lawn-mowers. Guide flanges are adjusted to fit the lawn-mower and the sharpener is run along it. A perfect edge is said to be obtained in a few minutes.



The sharpening is done by a stone cylinder. To secure a fresh sharpening surface, this is rotated slightly. When the stone is full of steel, it may be removed and cleaned in gasoline or soap and water.

INSOMNIA may be cured simply by decorating and upholstering one's bedroom in a quiet, subdued blue, according to the recent statement of a prominent French physician. Red both tires and excites, green makes one happy, but blue brings rest and sleep, he says.

Heavy Metals Kill Germs by Stealing Sulphur

COMPOUNDS of the so-called "heavy metals," like gold, silver, mercury, copper, and lead, are effective disinfectants because they break down the delicate chemical balance in living matter by robbing it of its sulphur. Results of researches embodying this theory were presented recently to the National Academy of Sciences by Drs. Carl Voegtlin and J. M. Johnson and Miss Helen A. Dyer, of the Hygienic Laboratory at Washington, D. C.

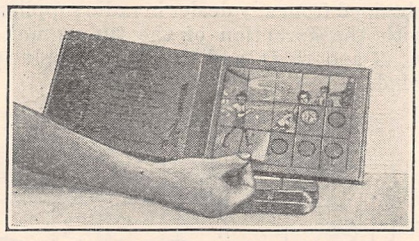
The investigation was undertaken to find out the fundamental chemical cause for the poisonousness of such common disinfectants as bichloride of mercury and copper sulphate. Doctor Voegtlin and his associates learned that the greed of these metals for sulphur lay at the bottom of the violence of their attack on living matter Doctor Voegtlin discovered further that he could neutralize the poisonous effects of compounds of the heavy metals by adding to them compounds containing the sulphur-hydrogen group.

He says that though this discovery goes to the bottom of the chemical action of this class of disinfectants, immediate applied results can not yet be expected.

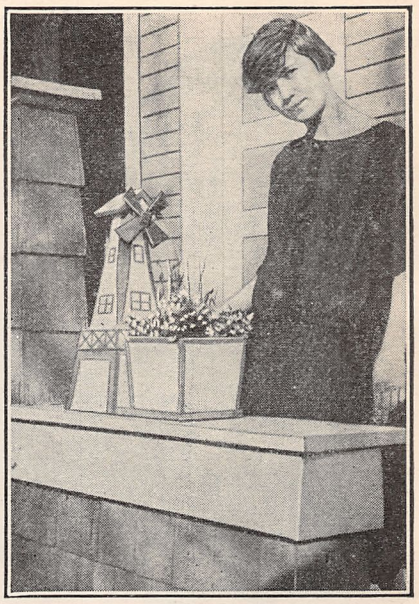
Novel Thrift Bank Hidden in a Picture-Book

IN ORDER to encourage small children to save pennies, nickels, and quarters, and at the same time make the habit novel and interesting, a thrift bankbook has been invented.

The child puts his coin in a circle in one of the cardboard pages of the book and over it pastes a gummed section of a picture. The more coins he saves, the quicker the picture will be completed. There are pages for coins of different values. When filled, the book holds five dollars. The hidden treasure can be removed when all of the pictures are finished, and other picture stamps used.



A partly filled page of the thrift book



Self-Watering Flower-Pot Has Windmill Attachment

WITH a reservoir containing a water supply that needs to be replenished only every four or five weeks, a self-watering flower-pot has been patented recently. A windmill at the left of the ornamental flower-box acts as a reservoir. The flower-box also is provided with a ledge, and a porous inner receptacle is placed beneath the flower-bed so that a continuous supply of moisture is furnished directly to the roots of the plants.

How Much Do YOU Know about Science?

THE following 12 questions, each relating to some fundamental fact of science, were selected from hundreds of queries sent in by the readers of POPULAR SCIENCE MONTHLY. How many of them can you answer correctly?

Do the best you can, then turn to page 111 and see how nearly you were right.

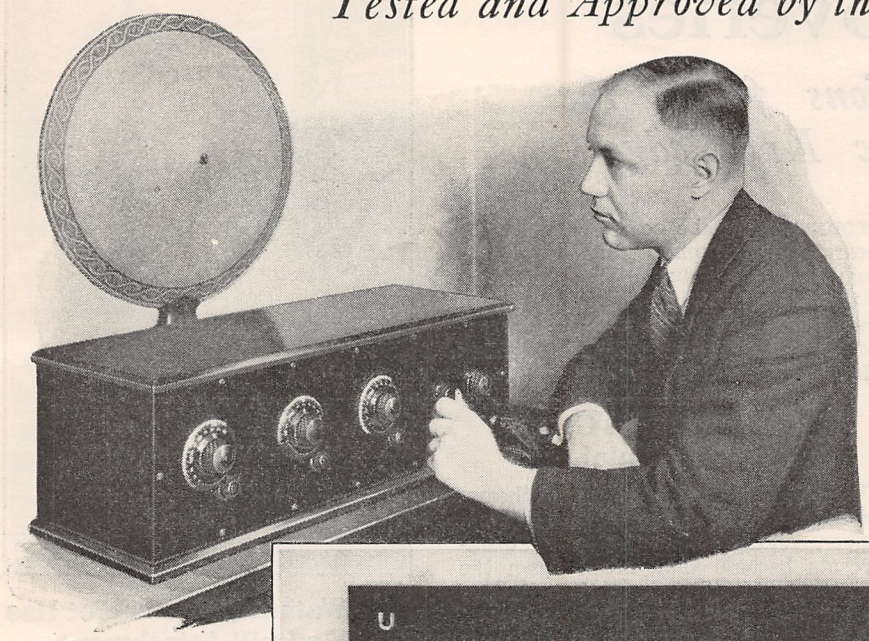
1. How much air do you breathe?
2. Does it use up energy to think?
3. What indications have we that man's ancestors had tails?
4. Why can one touch a red-hot iron with a wet finger and not be burned?
5. How can you tell whether a piece of jewelry is made of platinum or of silver?
6. Why does asbestos not burn?
7. What would happen if the earth collided with a star?
8. How do trees become petrified?
9. Why do ants keep little cows?
10. Are radio waves the same as light waves?
11. Why does blotting-paper absorb ink faster than ordinary paper does?
12. Why is there no air inside an electric lamp bulb?

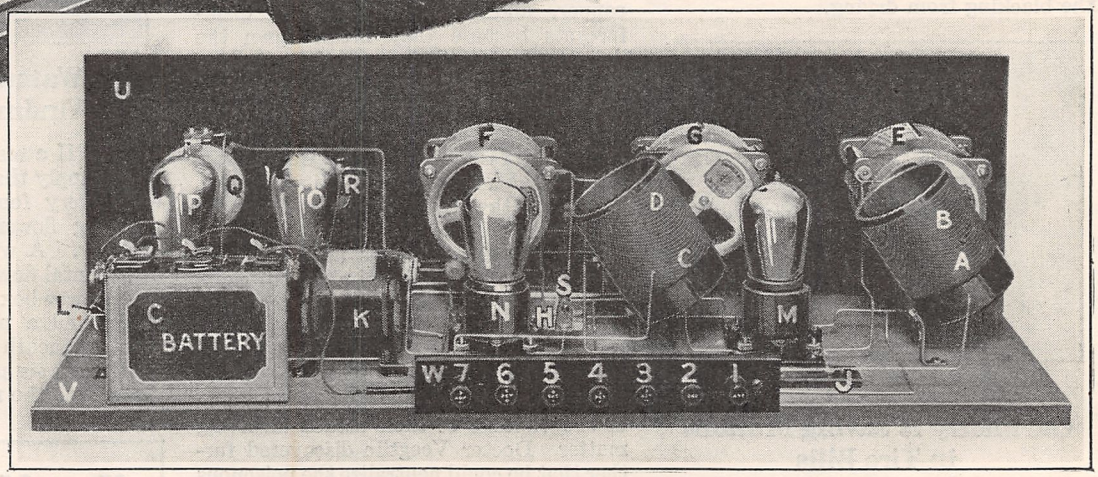
Tested and Approved by the Institute of Standards

An Up-to-the-Minute

Four-Tube Receiver

Easy to Build—Gives Maximum Results





Blueprints Are Available

The view of the completed four-tube receiver above shows the attractive panel layout. The rear view at the right (Fig. 1) shows the simplicity of construction. Blueprints for this remarkable set are available and will be found listed in the tabulation of the Popular Science Monthly Blueprint Service at foot of page 89

By Alfred P. Lane

HERE is a radio receiver that will appeal to novice and expert alike. The novice will find it easy to build and the expert certainly will be satisfied with the way it brings in distant stations without sacrifice of selectivity or volume.

The Popular Science Institute of Standards has carefully tested the model receiver shown in the illustrations and has reported that its sensitiveness is high and uniform, the selectivity excellent, and the volume and tone all that could be desired.

One stage of radio-frequency amplification is used, the detector is regenerative, and there are two stages of transformer-coupled audio frequency.

Tuning is exceptionally easy, first, because there are only two tuning controls; second, it is possible to find stations quickly by throwing the detector tube into oscillation; third, regeneration as obtained in this receiver does not at all affect the wave-length adjustment.

Another advantage that will appeal to the home constructor is the absence of moving coils. Getting rid of the rotating tickler coil, often employed in circuits of this type, kills two birds with one stone. It eliminates the mechanical work of mounting a rotating coil, which is troublesome to many amateur builders, and there is an electrical advantage in eliminating the moving magnetic field, which often is responsible for distortion through feedback to other coils with which it is not supposed to couple.

Instead of the usual interstage control by means of jacks, the volume is adjusted by turning the knob on variable resistance *R*. The elimination of interstage jacks also makes it possible to use one rheostat to regulate the filament current in all four tubes, and the wiring therefore is reduced to the utmost simplicity.

All of the parts used in the receiver are of standard construction and can be obtained from any dealer in radio supplies, with the exception of the tuning units *A*, *B* and *C*, *D*, and these are simple to wind.

The receiver is designed for use with an outdoor antenna from 75 to 100 feet long. It will be found, however, that it is sufficiently powerful to give excellent volume on local stations when a short indoor antenna is used.

HERE are the parts you will need:

A and *B*—radio-frequency tuning unit.

C and *D*—detector tuning unit.

E and *F*—variable condensers, .0005-mfd. capacity.

G—variable condenser, .00025-mfd. capacity.

H—grid condenser, .00025 mfd., with clips for grid leak.

J—balancing condenser.

K and *L*—medium ratio audio-frequency transformers.

M, *N*, *O*, and *P*—vacuum-tube sockets.

Q—rheostat, 6 to 10 ohms.

R—variable resistance, 10,000 to 100,000 ohms.

S—grid leak, 4 megohms.

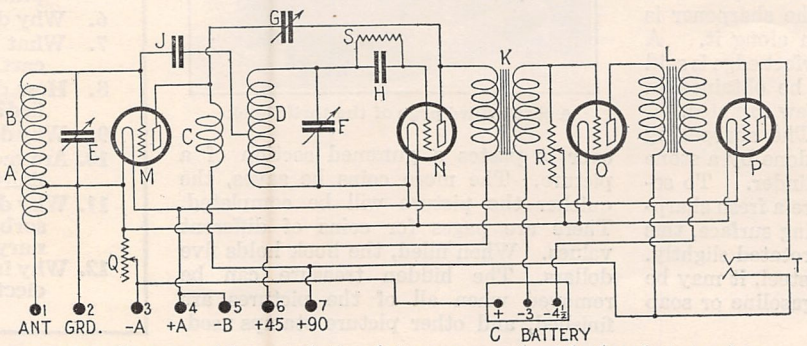
T—open-circuit jack.

U—composition panel, 7 by 24 inches.

V—wooden baseboard, ½ by 8 by 23 inches.

W—composition binding-post panel, 1¼ by 8 inches.

Two pieces of hard rubber or other com-



Wiring diagram with parts lettered to correspond with the photographs

position tubing 2½ inches in diameter by 3 inches long; ¼ pound of No. 22 double silk-covered wire; three 3-inch dials; seven binding posts, also the brass brackets, bus wire, and so on.

READERS may wonder why the grid leak *S* is specified as 4 megohms instead of the more common 2-megohm grid leak. The reason for this is because the model receiver gave slightly better results in the Popular Science Institute of Standards laboratory with the higher value of grid leak. The value of the grid leak depends on the tube with which it is used, however, and you may find that a lower or higher resistance at this point will give you better results with the tubes you use.

Just as a chain can be no stronger than its weakest link, so the value of any home-built radio receiver depends on all of the parts that go to make up the electrical circuit. It is a mighty good idea to write to the Popular Science Institute of Standards for a list of radio apparatus approved by the Institute and it will also help if you will take this copy of the magazine with you when you go to your dealer to purchase the parts.

The variable condensers can be of any good make and you will find it worth while to have them fitted with verniers, either the built-in type or in the form of Vernier dials.

The balancing condenser *J* can be of the tubular type shown in the illustrations, or you can use one of the midget condensers ordinarily sold in most radio stores for use as Vernier tuners.

Upon the quality of the audio transformers *K* and *L* will depend the kind of reproduction you will obtain from the loudspeaker. Good audio transformers cost money, but they certainly are worth it.

The rest of the parts do not need comment. Any standard make will do. It is advisable, however, to purchase sockets suited to the standard 6-volt storage-battery type of tube, since a number of dry-cell tubes are made to fit this same socket.

After you have bought all the parts, including the cabinet, you are ready to proceed with the construction of the receiver. Note that the arrangement of the parts shown in the model receiver calls for a cabinet 8 inches deep. It is possible to crowd the parts a bit and get the set into the usual 7-inch-deep cabinet, but you will find it much more satisfactory to use the deeper cabinet.

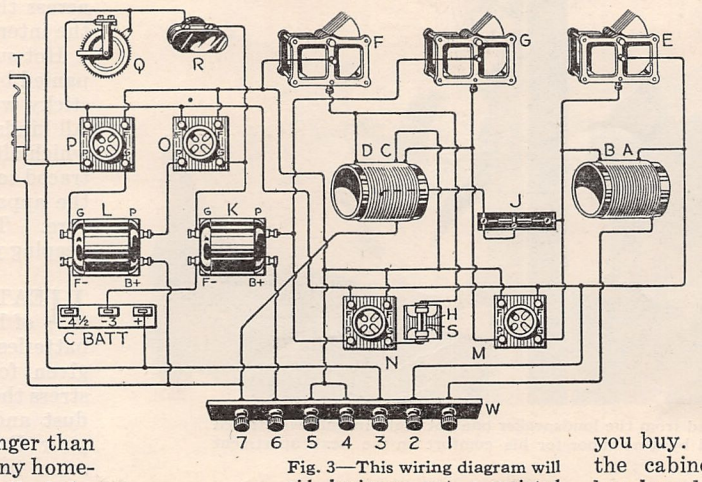


Fig. 3—This wiring diagram will aid beginners not acquainted with the radio symbols in Fig. 2

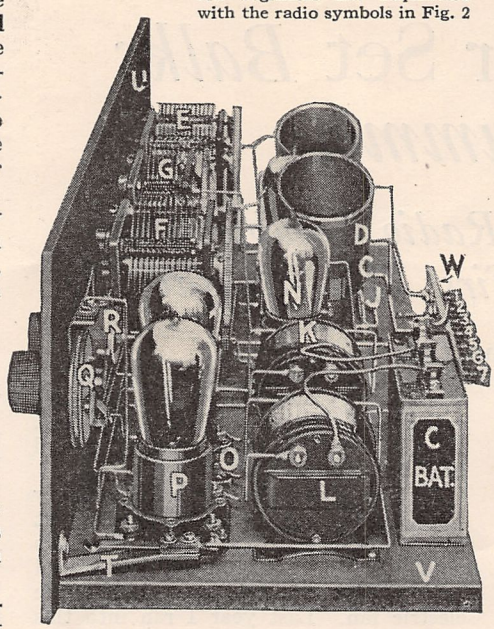


Fig. 4—Side view of the set showing the layout of the two-stage audio amplifier. Notice particularly how the C battery is hooked up

The first operation is to lay out and drill the panel according to the dimensions given in Fig. 6 on page 113. Only center holes for the various instruments are given.

After you have the panel drilled, fit it to the cabinet. You may find that the row of screws that hold the panel at the top should be ⅛ inch from the edge instead of ¼ inch, as shown in the panel drawing in Fig. 6. This will depend on the cabinet you buy. Screw the panel firmly into the cabinet and then hold the wooden baseboard against the bottom of the cabinet and the back of the panel. Then you can spot the holes for the screws that hold the panel to the baseboard through the holes that already are drilled in panel.

The next step is to fit the binding-post panel *W* to the baseboard and cut the opening for it in the back of the cabinet. The easiest way to cut a hole of the proper size is to use a keyhole saw, starting it with a ⅜-inch hole.

WHEN you are satisfied that the cabinet and panel fit, proceed to mount the instruments fastened to the panel.

The winding of the tuning inductances *A*, *B* and *C*, *D* should be done next. Take one piece of the tubing mentioned in the list of parts and drill two small holes ⅛ inch from one edge and about ¼ inch apart. Now turn the tube around halfway and drill two more holes ¾ inch from the other end. Then drill a hole for the brass bracket shown in Fig. 1. Next wind 8½ turns of wire, beginning at the lower end, and twist a loop for a tap as shown in Fig. 5. Continue the winding

(*Continued on page 113*)

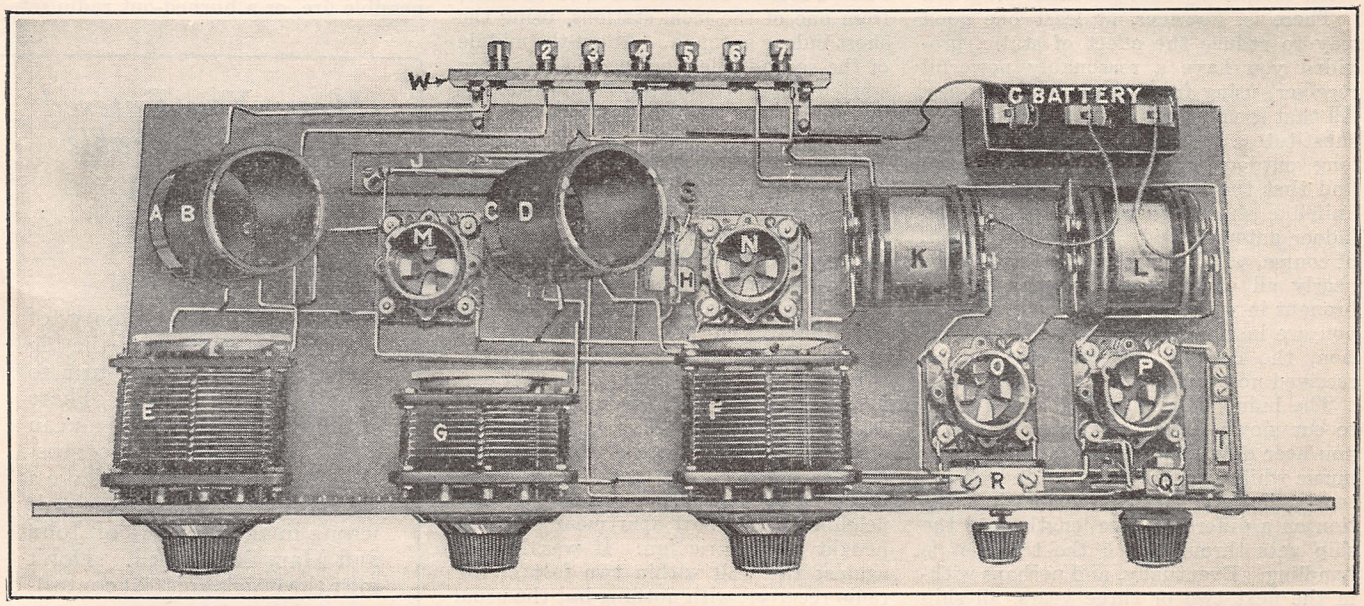
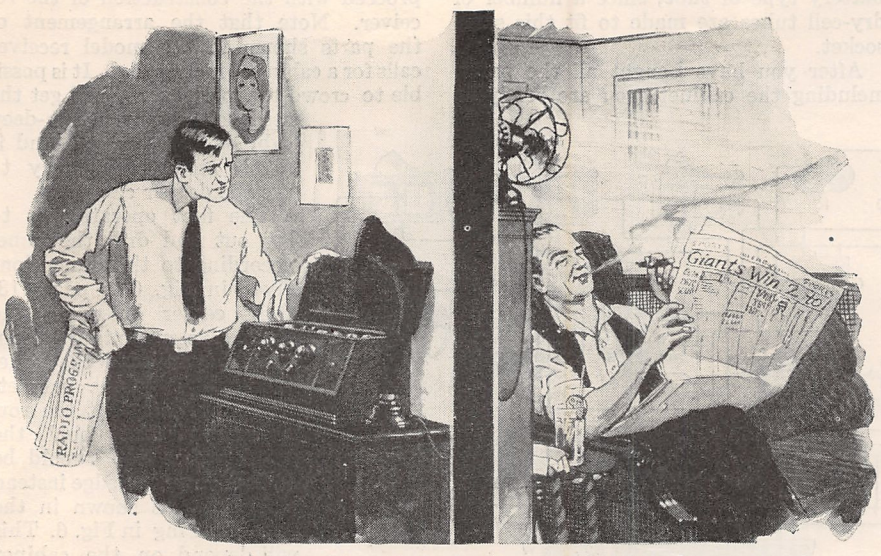


Fig. 5—View of the four-tube radio receiver from the top, showing in detail the arrangement of parts and wiring



A crackling buzz, that issued from the loudspeaker one hot night in June was traced to an electric fan installed by a neighbor for his comfort in the next apartment

When Your Set *Balks* in *Summer*

How to Cure the Radio Troubles that Come with the First Hot Weather

By John Carr

POOR radio reception in summer is looked on by a number of radio fans as a necessary evil, like the income tax. And this is true as far as several kinds of troubles peculiar to summer are concerned. No one yet has found a good way to eliminate static, for example.

In winter there are occasional nights when static noises are severe enough to bother reception, but with the first warm weather, these annoying crackling and crashing sounds increase so that they often completely ruin the finest program.

There is, however, at least one good way to reduce the effect of static, provided you have a reasonably powerful receiver, using from three to five tubes. All that is necessary, in most cases, is to substitute a short indoor antenna for the long outdoor one. You probably will find that the receiver tunes with almost knifelike sharpness when used with an indoor antenna, and the signal strength, of course, will be much lower. However, nearly all of the local stations can be brought in with plenty of strength and if you are in a particularly favorable location, the distant stations also will be received now and then.

The indoor antenna likewise will help to cut down code interference, but if you hear dots and dashes along with the music while you are using an indoor antenna, the only remedy is to tune in a station on a different wave length until the ship gets through with the traffic it is handling. Eventually, and perhaps within the next two or three years, all ship transmitters will be of the continuous-wave variety and interference from this source will then be a thing of the past. In the meantime you must grin and bear it.

Various kinds of electrical machinery cause trouble for the radio listener, but this source of interference, like the ship's dots and dashes, is of the all-year-round variety with one exception, and that is the electric fan. Last year I ran into this type of interference in a particularly aggravated form. One hot night in mid-June, I settled down to listen to a concert from one of the local stations, using the short indoor antenna. About the middle of the second selection, a crackling buzz started that completely drowned the program.

THE first thought that occurred to me was that something had gone wrong at the broadcasting station, but when it kept up for several minutes, with no change in intensity, it became obvious that nothing was wrong at the station, for the monitor at the studio would certainly have discovered and remedied such a disagreeable noise.

I went over the battery connections, fiddled with tube contacts, and did almost everything I could think of. Finally I decided that some form of electrical machinery was to blame and I set out to find the offender. I found it easily. My neighbor in the next apartment had just bought an electric fan. It was located against the wall within two feet of my radio receiver, with nothing but the usual wood-and-plaster partition between.

It cost me about two dollars to cure the trouble, since I could not very well insist that my neighbor stop using his new electric fan. Being a true neighbor, however, he was kind enough to allow me to connect a one-microfarad condenser across the brushes of the fan motor, and the interference immediately stopped.

Hot summer weather usually is accompanied by excessive humidity, and damp, sticky weather is bad for radio receivers. All kinds of sizzling and crackling noises, which often closely resemble static, can be traced to leaks caused by a film of dust on the apparatus that has soaked up moisture. Thus there are advantages in keeping your radio receiver free from dust.

HEAT and dampness also are enemies of batteries in general, and dry-cell batteries in particular. Instructions given for the care of batteries always stress the value of keeping them free from dust and in a relatively cool place. If your B batteries, for instance, do not seem to last as long as they should in summer, you may be to blame. Perhaps you have them located where the hot sun shines on them for hours at a time. This is bad practice. A layer of damp dust allowed to collect on the wax tops of dry-cell batteries causes a steady leak, so keep the tops of the batteries clean.

Obviously, the radio receiver itself should not be kept in a place exposed to dampness. A location which is perfectly satisfactory in winter may not be at all suitable in summer. A near-by window, for example, will be open a good part of the time in summer, although closed during the winter.

Another matter of importance to the radio fan during the summer is the use of a lightning arrester. The chances of trouble from lightning are, naturally, rather remote in winter, but the omission of this apparently unimportant accessory may lead to serious trouble in summer.

If you have neglected to install a lightning arrester, now is the time to get one. Make sure that it is of a type approved by the Board of Fire Underwriters and also be sure that you connect it properly. It is much better to be safe than to run a chance of a severe shock, a possible fire, or a burned-out radio set.

Have You Entered Our Remarkable

$10,000

Contest

?

YOU still have plenty of time to win one of the big cash prizes. Simply turn to page 19 of this issue. There you will read just how you can enter this fascinating competition. You are sure to have a lot of fun finding out what's wrong in the pictures of John and Mary Newlywed. Don't miss the year's greatest contest.

Herbert Hoover Joins One-Bulb Fans

Novelties of the Month in Radio

Learns the Little Fellow's Troubles

The big boss of radio, Secretary of Commerce Herbert Hoover, has invested in a simple one-tube receiver. He listens in with this outfit to learn first hand the problems of the millions of owners of simple sets in the United States

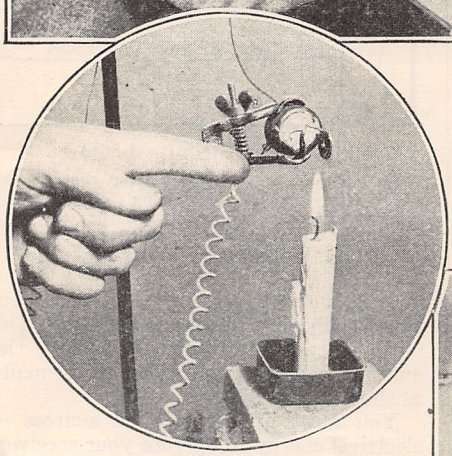
Radio Bonnet

This queer millinery "creation" made entirely of radio parts, was exhibited recently in San Francisco by Miss Vera Luddy. Antenna wire, spaghetti, dials, and small articles form the hat, which is surmounted by three insulated lead-ins

A Radio Traffic Cop

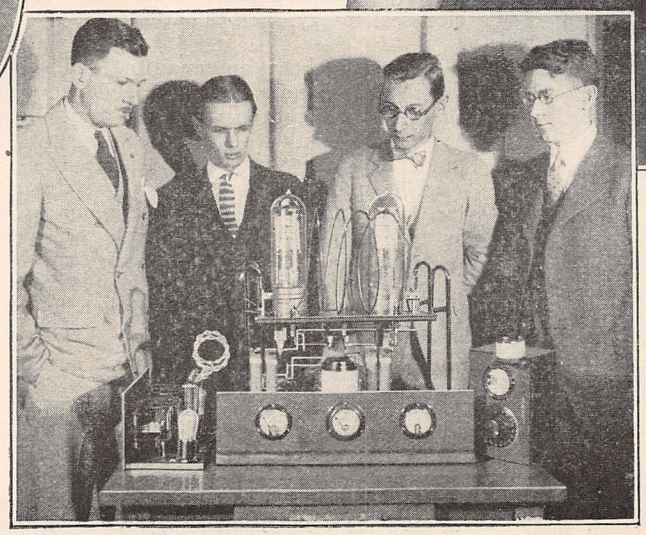
Here is M. S. Strock, of the U. S. Bureau of Standards, checking broadcasting wave lengths with apparatus of extreme accuracy. Thus Uncle Sam makes broadcasters keep to their own wave lengths

© K. & H.



Electricity Rides on Flame

A novel way of showing how electricity travels through space. The candle flame throws off electrons as does a vacuum-tube filament and current flows between two wire disks



Broadcasting Radio Convention

At the right is the high-powered low-wave transmitter used to broadcast proceedings of the first International Radio Convention, held in Paris

Rare Bird Sings to Microphone

One of the performers in a joint recital recently given before the microphone in a New York broadcasting station was a rare bird known as the "troupial," whose native haunts are along the Amazon River in South America. The other performer was Miss Kay McRae, on whose shoulder the bird perched throughout the recital

How to Install Your Radio Set

Are You Getting the Best Results?—An Expert Tells How to Check Up on Your Antenna, Tubes, and Batteries

By James E. Smith

A FRIEND of mine is in the radio business. A couple of days ago I dropped into his store for a chat and while I was there the phone rang. A woman was on the other end of the wire, judging from my friend's replies, and it was obvious that she was the owner of a radio receiver that was not working right.

My friend assured her that he would send a man around at once, jotted down the name and address, and handed it to the service man.

Fifteen minutes later the service man returned. His face registered extreme disgust.

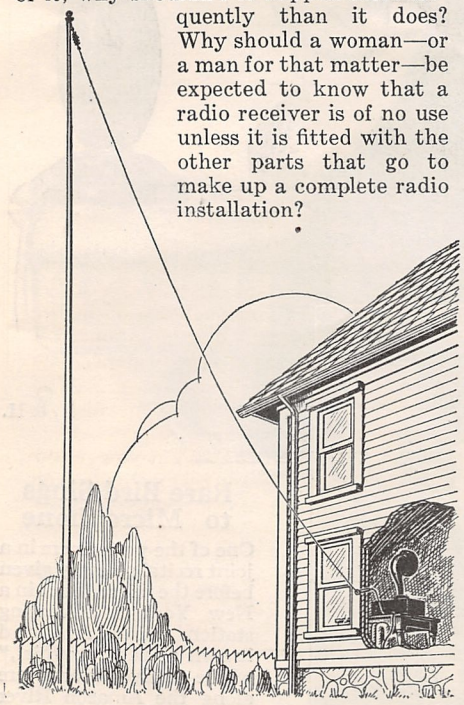
"Well, what was the trouble?" said my friend.

"Nothing—nothing at all!" the repairman growled. "She ordered that set by phone from a department-store bargain 'ad,' not noticing that 'without accessories' joker and—"

"And I suppose something was missing," my friend broke in, grinning.

"I'll say there was," the repairman went on. "No tubes in the set, no batteries, no antenna—not even a loudspeaker. She was just sitting there twiddling the dials and expecting the music to come out through the pores in the wood, I guess!"

That incident actually happened, ridiculous as it may seem; and, come to think of it, why shouldn't it happen more frequently than it does? Why should a woman—or a man for that matter—be expected to know that a radio receiver is of no use unless it is fitted with the other parts that go to make up a complete radio installation?



A One-Support Antenna

The absolute minimum for antenna support consists of one insulator at the far end of the antenna, with the near end directly connected with the antenna binding post of the receiver, as shown above

Which Tube Is the Good One?

You can't tell by the looks, for all vacuum tubes look about alike. To be sure of getting good ones, buy them from a reputable dealer and have them carefully tested before purchase

New people are becoming interested in radio all the time; and for the benefit of these novice radio fans, it may be well to go over, briefly, the most important details that must be attended to before the radio installation can be considered first class. Fans who already have sets in operation also will be interested, because they can check their own outfits to see how near they come to ideal installations.

A complete radio installation consists, essentially, of a means for collecting the radio waves—the antenna system; an apparatus for converting these radio waves into electrical impulses in a usable form—the radio receiver proper; a device for changing the electrical impulses into sound waves—the loudspeaker; and a source of electrical energy, such as batteries.

CONSIDER the antenna first. The ideal antenna would be a single wire running straight up to a height of from 75 to 100 feet, and without supports of any kind. Obviously, such an antenna is impossible, but it does give us a goal to strive for. See, therefore, that your antenna is as high as possible. For example, a 50-foot antenna that is 35 feet above surrounding objects would be more effective in bringing in distant stations than another antenna 100 feet long stretched 10 feet above the ground.

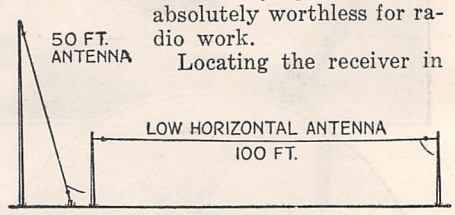
While it is impossible to erect an antenna without supports, you can use the minimum number of supports and insist that the ones you do use have the best possible electrical insulating properties. The absolute minimum number of supports is one insulator located at the far end of the antenna, with the near end directly connected with the antenna binding post on the receiver.

Very few radio fans are located where such an arrangement is possible. The more usual installation consists of an insulator at each end of the wire, with a wire coming down from one end of the antenna to the radio set. Remember that the antenna should be strung so that it will not sway with the wind.

A GOOD ground connection is just as important as a good antenna. A solid connection witht he nearest cold-water pipe is nearly ideal.

Do not forget to include a good lightning arrester in your antenna-ground circuit. It will not affect the efficiency of your reception and it may save a serious fire or injury to your receiver.

The next step is to see that your receiver is equipped with good vacuum tubes. This is extremely important. All tubes look about the same, but looks are no criterion for vacuum tubes. Buy them from a reliable dealer and make sure that he tests them carefully in a good tube-testing circuit that will indicate the operating characteristics of the tube. Merely testing to see if the filament will light means nothing at all except that the tube is not burned out. A tube may light and yet be absolutely worthless for radio work.



The High Antenna Is Best

An antenna only 50 feet long that rises 35 feet above surrounding objects is more effective in bringing in the distant stations than an antenna 100 feet long stretched only 10 feet above the ground

Locating the receiver in your home is usually a compromise between efficiency and good looks. The ideal place for efficiency is where the antenna lead and ground lead can be made as short as possible.

You must have two good sources of electrical energy to operate your receiver. One is used to heat the filaments of the vacuum tubes; the other, of much higher voltages, actually operates the electrical circuits in your set.

The types of batteries you need will be determined by the vacuum tubes for which the receiver is designed. They may be storage batteries or dry batteries.

This brings us to the last important item in the installation of an ideal radio receiver—the loudspeaker. The best way to select a loudspeaker is to listen to several, then choose the one that pleases you most, for it will be a matter of choice.

Is Your Car in Summer Trim?

By Martin Bunn

Good Advice from a Veteran

When Mr. Stevens drove up to the Model Garage to have his sedan looked over, Gus told him a list of the little jobs that any owner can do himself to prepare for summer tours. You will find them in the accompanying story, just as Mr. Stevens jotted them down

A Fascinating New Series of Stories in Which Two Veteran Auto Men Tell You How to Save Worry and Expense

EARLY summer is the busy season for the automobile repairman. With cars to overhaul, valves to grind, ignition systems to be readjusted, and a thousand and one other jobs to be done for motorists who are preparing for a summer of touring, the average garage is likely to find itself snowed under, and Wilson & Clark's Model Garage was no exception.

"Seems as though every one who ever owned a car wants something done," complained Gus Wilson wearily, as he got out the creeper preparatory to sliding under another car to examine the brake rods.

Wilson was the mechanic of the firm, a gray-haired veteran of the automobile repair shop, who had been working on automobiles since the days when they were called "horseless carriages."

"The more the merrier, Gus," grinned Joe Clark cheerfully, as he picked a time slip from the steering-wheel of the car on which his partner had just finished working.

Clark was the "figure man" of the combination, an expert bookkeeper who did all the pencil work for the firm. He was happiest when a rush of work that meant sleepless nights for his partner permitted him to make many entries in his books and many deposits in the bank.

A fine sedan rolled in from the street. Clark's grin widened as he observed—another car over which his tired partner would grumble while performing the best repair job of which he was capable.

"Good morning, Mr. Stevens," he greeted the driver of the car as the latter threw open the door and stepped out. "What's the trouble this morning?"

"Not a thing," responded the other. "Nothing that I know of, anyway. But I'm going on a long tour next week, and I thought, if Wilson wasn't busy, it might be well to have him look the car over, and see if there's anything that needs attention."

"Good idea, Mr. Stevens," nodded Clark. "A lot of our customers would save themselves trouble and money if they got in the habit of doing that. Hey, Gus!" he called to his invisible partner. "Take a look at Mr. Stevens' car, won't you?"

Wilson was muttering to himself as he emerged from beneath the automobile on which he was working. His grumbling ceased, though, and a smile replaced his frown as he glanced toward Stevens' car, shining in the morning sunlight, spic and span as a battleship, its motor purring quietly—obviously a car in which the owner took great pride; a car that had not been abused.

"Humph, doesn't look as though there could be much wrong with *that*," observed Wilson. "What seems to be the trouble with her?"

Stevens repeated what he had previously told Clark, and Wilson, nodding his approbation, stepped into the driver's seat, followed by the owner.

He pushed down the throttle a couple of times, meanwhile listening intently to the response of the motor, then backed the car out and drove over his usual test route, which included a near-by hill. They were back in the garage in a few minutes.

"Not a blessed thing wrong with her—now," said Gus, as he followed Mr. Stevens out of the car.

"Why 'now'?" asked the owner anxiously. "Is anything likely to—"

"OH, NO," Wilson told him; "but there are a lot of things you ought to do before you start on a long tour. If you have a piece of paper, you might jot them down. You can attend to them just as easily as I can."

"Why, I thought you garage fellows were always against an owner tinkering with his car!" exclaimed Stevens in surprise.

"Tinkering, yes," said Wilson; "just turning nuts and taking things apart without any idea of what you're doing. But things would be a lot easier for everybody—owner and mechanic—if owners would learn to do the little jobs themselves.

"For instance, while we were riding along, you may have heard a little rattle in front.

Gus and Joe Have a Lot of Valuable Tips for You

WITH this article we introduce to the readers of POPULAR SCIENCE MONTHLY two most interesting characters—Gus Wilson and Joe Clark, proprietors of the "Model Garage."

Gus is a veteran automobile mechanic; Joe, his partner, the "figure man" of the combination. Both of them know the automobile game thoroughly from their respective angles. Both of them, in consequence, have a wealth of valuable suggestions to make to the automobile owner who wants to get the most out of his car.

Each month in future you will meet Gus and Joe in these pages. Gus will disclose to you all the little mechanical kinks and dodges he has learned in his experience; priceless "tips" on how to keep your car running efficiently at all times. Joe, on the other hand, will tell you how to keep your motoring costs down—how to buy tires, how to cut your gas and oil bills; things of that sort.

Mr. Bunn has written a fascinating series of these articles. We hope you will find them, as we have, not only the most interesting reading you have encountered in months, but the very best articles from a standpoint of practical use to the automobile owner that ever have been printed anywhere.—THE EDITOR.

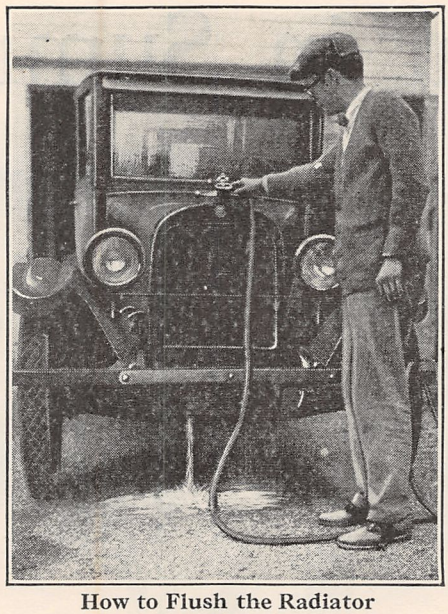
Your license plate is loose. It will take you only a second to get a wrench and screwdriver and tighten it. And, when you have your wrench and screwdriver handy, why not go over the car from stem to stern and try every single nut and screw? If any are loose, tighten them. On a new car like yours the parts set, sort of, after you've driven it awhile, and sometimes half a turn on a nut will keep it tight and save you a big repair bill.

"FROM the looks of your car and what I know about you, it's safe for me to assume that you're keeping the car oiled and greased properly. But there are quite a lot of little things that a man like you, who's about to make a long trip, ought to do before he starts. Ready with the pencil?

"Summer touring, especially through hilly country in a car full of passengers and baggage, is likely to bring out the defects in the cooling system. Better flush out your radiator to remove the dirt and rust. The easiest way to do it is to run your motor just a little bit faster than the usual idling speed and run water into the radiator filling cup from a hose while the drain cock at the bottom of the radiator is open. When the water begins to run fairly clean, you can consider the job finished.

"When I shut off your ignition just now, I noticed that the fan turned over a few times after the motor had stopped. You'd better take up the play in the fan belt. Make it just tight enough so that you can turn the fan by hand and not too easily. When you're running against the wind, plenty of air passes through your radiator to your motor. In fact, if you always could run against the wind, you wouldn't need a fan at all. Running with the wind, though, you're absolutely dependent upon your fan to suck in air and cool the motor, and, if the belt is loose, there won't be any air sucked in. If the day is hot, your motor will boil sure as shooting, particularly if you have to make many traffic stops.

"YOUR ignition system is working fine now, but it would be a good idea to clean all your spark plugs—just on general principles. Don't forget, either, to put a couple of spare plugs in your toolkit before you start. Also, you might clean the breaker contacts in the timer—file them square—and reset them according to the thickness gage in your toolkit. If you don't do this, they may get pitted badly enough to make the motor miss and make starting difficult.



How to Flush the Radiator

"The easiest way," says Gus, "is to run the motor a little faster than idling speed, then let a stream of water from the hose run into the filling cup while the drain cock at the bottom of the radiator is allowed to remain open

"That will be about all for the ignition," went on Wilson after pausing to permit the other to catch up in his notes. "Of course, you'll make sure that all wires are tight? Now, let's see what ought to be done about the gas line."

He "tickled" the carburetor, and noted the time it took for the gasoline to overflow.

"Humph," he commented. "I thought so. Remember that the car slowed down just a little near the top of that hill we climbed? Your gasoline pipe is clogged up just enough to cut down the supply a little when the throttle is wide open. Better clean it out, or it will get worse and worse until your motor may not run at all. And while you're about it, you might as well clean out the little filter in the top of the vacuum tank. In fact, you'd be much better off if you had two filters—one between the main tank and the vacuum tank, and the other between the vacuum tank and the carburetor. If you don't want to tackle the job of installing them yourself—"

"No, I'll let you do it for me," interrupted the other. "But I don't see why two filters are necessary. Why isn't one enough?"

"Well," said the garage man, "every now and then the gasoline flows from the main tank into the vacuum tank with a rush—not in a steady, slow stream as it does from the vacuum tank into the carburetor. When this happens, the movement of the gas is so fast that there isn't time for the tiny particles of dirt to be filtered out. They won't pass through your second filter, though. Also, a second filter in the gas line will remove the larger particles that otherwise would clog the valves in the vacuum tank."

"THAT sounds reasonable," admitted Stevens. "I'll run the car in about Thursday, and let you put the filter in. How about taking up the brakes?"

"Won't do any harm," said Wilson. "They hold now, but they may not after a few hundred miles more of driving."

"And how about removing carbon and grinding the valves?" asked Stevens.

"Well, those jobs really aren't necessary just now," said Wilson. "Still, if you think this is the only chance you'll have to lay up the car for a day or two, you'd better have them done. And we might adjust the generator at the same time. Just now it's pushing too much current through the battery. It's all right to have 15 amperes going into the battery during the winter when you don't use the car so much and must use plenty of juice every morning when you start the motor. In the summer, though, when the motor starts on the first turn and you're taking long trips and consequently charging the battery almost constantly, it's advisable to cut the charging rate down to six or seven amperes. You'd be astonished to know how many batteries are ruined by too much charging."

"THAT'S something I never thought about," said Stevens.

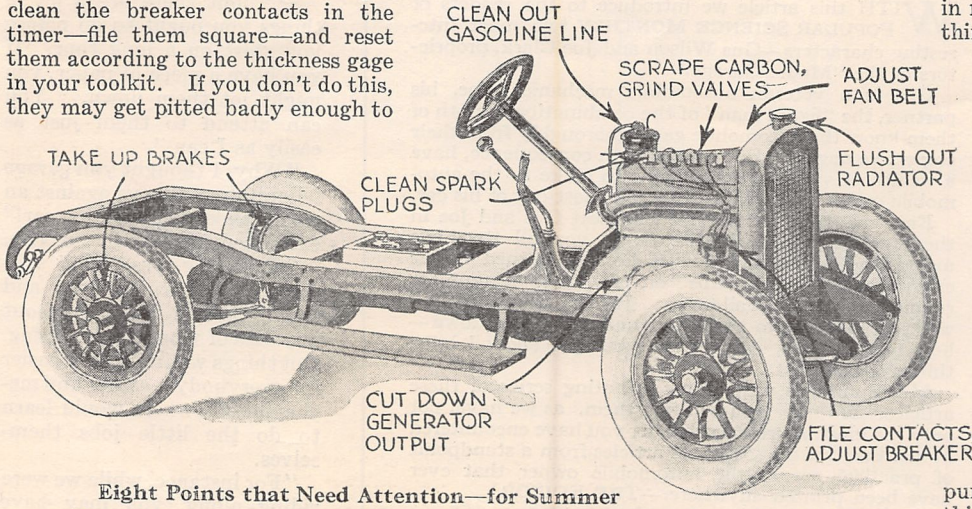
"It's just another one of the little points about a car that are neglected by the average owner until they lead to serious trouble and a big repair bill."

Stevens smiled. "I've found out that it pays," he said.

"You bet it pays," agreed Wilson. "All those little things that you're jotting down in your note book pay a car-owner in real money. And lest you forget anything in your hurry to get away, you'd better put these down as things that must be attended to before you start:

"Add water to the storage battery. Grease everything in sight. Pump up the tires—including the spare—to the proper pressure. Drain the crankcase and fill it with new oil. See that the radiator is filled with clean water and the gasoline tank filled with gas. Put a couple of spare light bulbs under the seat. And, of course, make sure that all of your tools are in the car.

"With the few little things I'm going to do for you, I'm willing to bet you that, unless you get a puncture, you won't have to do a single thing to this car all summer —except drive it!" boasted the capable garageman.



Eight Points that Need Attention—for Summer

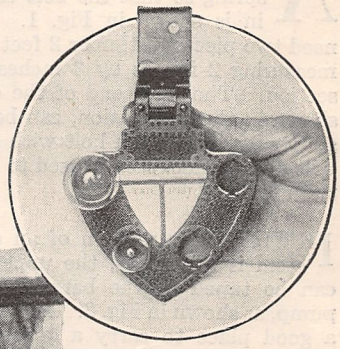
These eight points may mean the difference between pleasant riding for the whole summer, and constant trouble—with a big repair bill from the garage staring you in the face in the fall

Newest Aids for the Motorist

Useful Appliances Invented for Pleasure Car and Truck

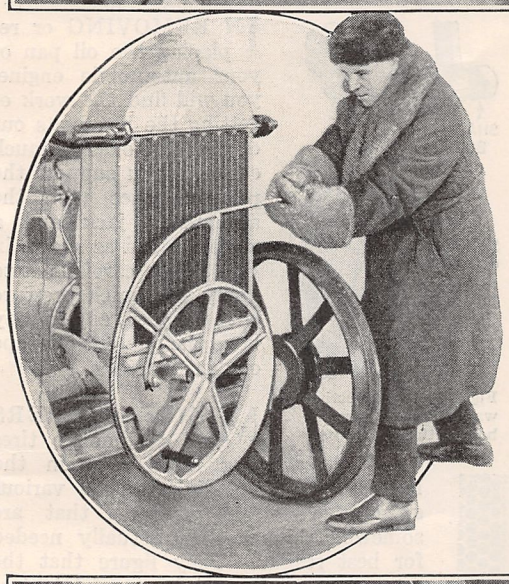
Auto Ceiling Compass

On long tours it is often difficult to know the general direction in which you are traveling, especially on roads that are not posted properly. Here is a compass designed especially for closed automobiles. It is fastened on the car ceiling and illuminated by a small bulb



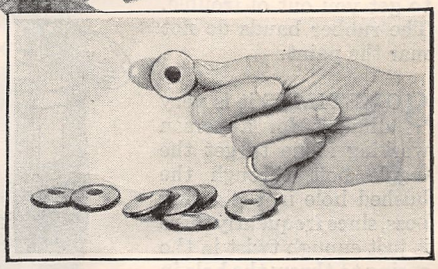
Spare Light

This device attaches back of the instrument board so that it turns up out of the way behind it when not in use, but is ready at a moment's notice if a light should burn out



Control Betrays Speeder

When operated within the speed limit, the green light shows; but as soon as the limit is exceeded, the green light goes out and the red light burns brightly. In addition, a horn sounds continuously. The picture above shows Lieut. Martin Noonan of the N. Y. Bureau of Public Safety, N. Y. Police Department, demonstrating this device

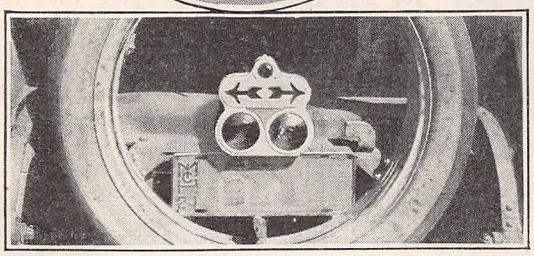


Rubber Spacers Aid Springs

It is claimed by the inventors that the rubber spacers shown above improve the riding qualities of an automobile when placed between the spring leaves

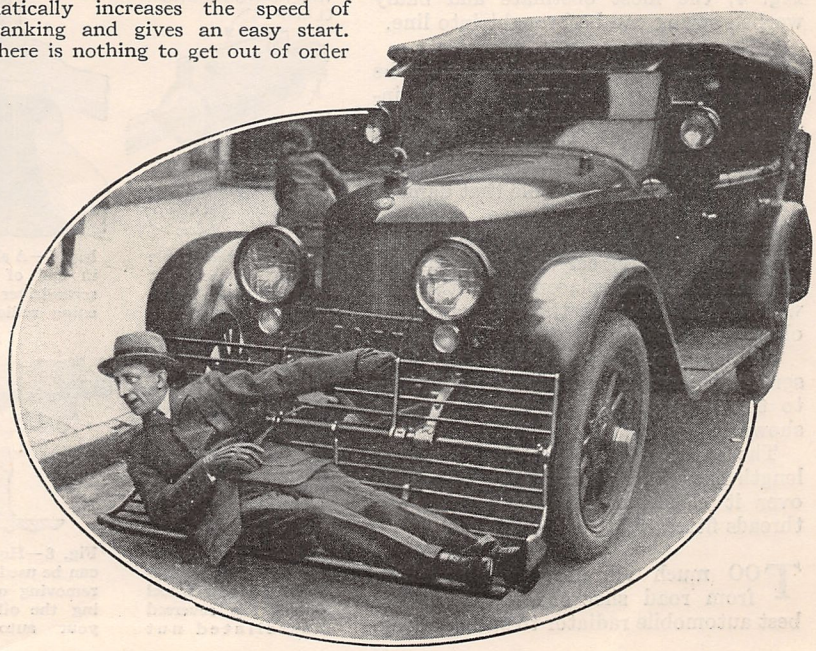
Rope Starter for Tractor

The spiral construction of the rope frame gives strong leverage to start the motor turning and then automatically increases the speed of cranking and gives an easy start. There is nothing to get out of order



Direction Arrows

Illuminated arrow indicates direction in which car is turning whenever front wheels are turned four degrees. The red "stop" signal is controlled by the clutch pedal as in other similar devices



Safety Fender

Here is a new arrangement of the "cow-catcher" idea to prevent pedestrians from getting under the wheels of automobiles. It drops into position upon impact or it can be lowered at will by the automobile driver

How to Save Money in Auto Repair

Easy Ways to Do Odd Jobs about Your Car

AN EASY way to compress a Ford rear spring so that the bolt can be put in is shown in Fig. 1. You will need two pieces of timber 2 feet long and measuring 2 inches by 3 inches in cross section. The right end of the clamp, as shown in the illustration, can be held together by means of a bolt with an 8-inch bolt at the end which is used to compress the spring.

IF THE lower portion of an old valve stem is sawed off, the upper portion can be taped to the barrel of the tire pump, as shown in Fig. 2. It will provide a good place to carry a spare cap and valve insides, so that if the usual small box of valve insides is misplaced, you always will have an emergency one handy.

WHEN you unexpectedly find that you need chains to pull you up a steep, muddy hill and there are no tire chains in the toolbox, you can use spare links held on with rubber bands in the manner pictured in Fig. 3.

Naturally you will have to start the car carefully, but if reasonably heavy bands are used, the chains will stay in place long enough to get you out of trouble. The rubber bands do not mar the paint.

SOMETIMES it is very difficult for a person working alone to get the toggle bolt through the bushed hole in the spring boss, since frequently there is just enough twist in the spring to throw the hole in the boss out of line with the holes in the toggle straps.

By using a heavy monkey-wrench and your automobile jack, as in Fig. 4, the most obstinate and badly warped spring can be brought into line.

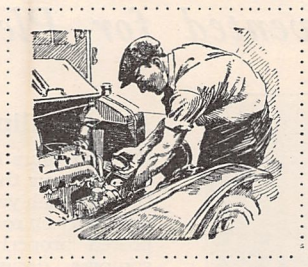
THE torque rod of a car may be strained and the threaded ends injured through improper application of a towline. If the towline is attached directly to an axle and the car is subjected to a jerk, it is very probable that damage will result.

In one instance the threaded end of the torque on a towing car was stripped from this cause. The replacement of the part was difficult because the car was of an obsolete model.

An ingenious repair, that was both serviceable and inexpensive, was applied to the stripped threads in the manner shown in Fig. 5.

The end of the torque rod was split lengthwise and the clamp that was placed over it closed up the threads so the threads fitted tightly.

TOO much vibration and pounding from road shocks will cause the best automobile radiator to spring a leak.



It is usually possible to tell at a glance when the radiator is loose, either by a slight push sidewise or by watching the radiator closely when the car is in motion. When the radiator is loose on its supports, the shell of the radiator will move back and forth enough so that the motion can be seen readily from the driver's seat.

A number of cars are so constructed, however, that it is very difficult to tighten the radiator bolts, because the bolt head is not accessible with any ordinary wrench.

The illustration in Fig. 6 shows how this difficulty may be overcome. A slot is sawed in the end of the bolt with a hacksaw. This permits the bolt to be held stationary with a screwdriver while the nut is being turned down tight.

The same scheme also can be used, of course, with any other bolt on the car that is hard to get at.

WHILE a wheel puller is the proper tool with which to remove the rear wheel on a Ford, an emergency method is to screw off the castellated nut and screw it on again with the castellated end toward the wheel, as in Fig. 7. Be careful, of course, to see that the end of the shaft does not project through the nut.

One or two sharp blows on the end of the nut usually will serve to loosen up the tightest wheel, with no chance for injuring the threads on the end of the shaft.

IN REMOVING or replacing the oil pan of your automobile engine, you will find the work of getting the last bolts out or the first ones in much easier if you support the pan in place with the automobile jack and a piece of wood as shown in Fig. 8. Be careful not to apply too much pressure with the jack, as you may bend the pan out of shape or dent it badly.

MANUFACTURERS of automobile tires long have been in the habit of recommending for the various sizes of tires air pressures that are somewhat higher than actually needed for best results. They figure that the average man will not be careful to test the pressure in his tires frequently, and since it is better from the standpoint of tire mileage to have a bit too much air than too little, the manufacturers' figures are justified.

However, this practice works to the disadvantage of the man who really takes pride in having everything about his car as it should be. He will keep his tires up to the recommended pressures and the result will be a hard-riding car. The solution of this problem is, of course, to scale down the manufacturers' recommendations about 10 per cent and then be sure to maintain this pressure.

It is well to keep in mind that the correct pressure for your rear tires is determined by the weight you are carrying in the car. Be sure to increase the pressure when you start a trip with the car loaded down with the full number of passengers.

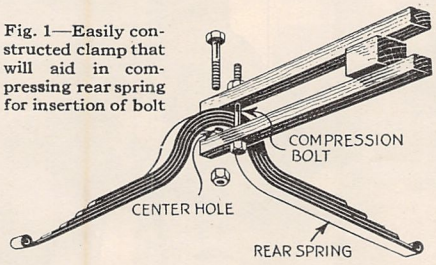


Fig. 1—Easily constructed clamp that will aid in compressing rear spring for insertion of bolt

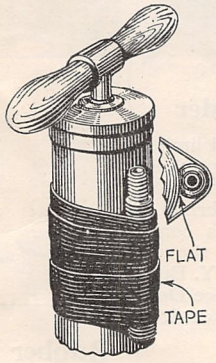


Fig. 2—Old valve stem taped to tire pump is a good place for an emergency valve

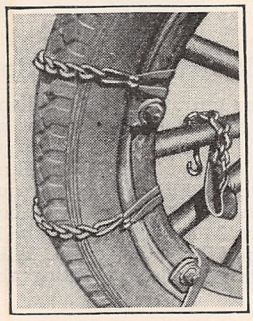


Fig. 3—Spare links held to the tire with rubber bands serve as emergency tire chains

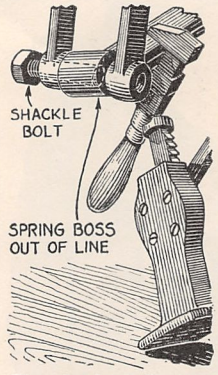


Fig. 4—An effective way of lining up spring boss with shackle bolt

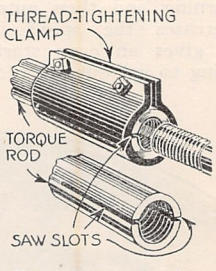


Fig. 5—A simple clamp device that can be used to repair a stripped torque rod

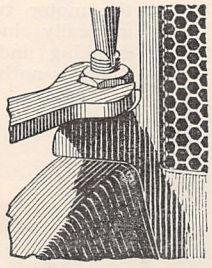


Fig. 6—A slot sawed in end of bolt for screwdriver for tightening radiator bolt

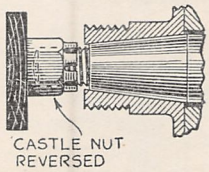


Fig. 7—An emergency method of removing Ford rear wheel is to tap reversed castellated nut

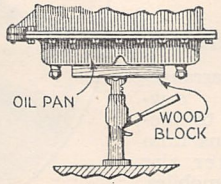
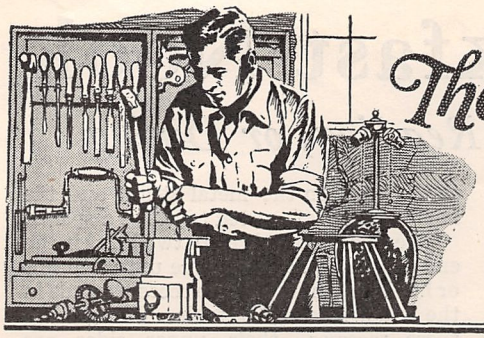


Fig. 8—How a jack can be used to aid in removing or replacing the oil pan of your auto engine

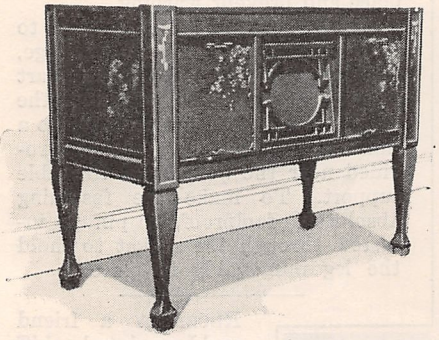


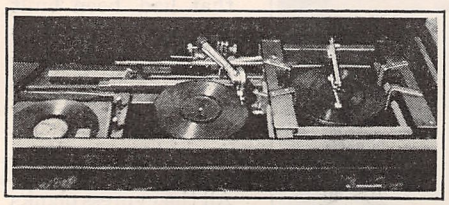
The Home Workshop

Arthur Wakeling, *Editor*

Amazing Feats of Home Workers

Prize-Winning Contributions in Handicraft Photo Contest





Automatic electric phonograph in hand-carved case by Roy L. Gerding, which won first prize

PRIZES in POPULAR SCIENCE MONTHLY'S recently concluded Handicraft Photo Contest are awarded as follows:

First Prize, $25, Roy L. Gerding, of Philadelphia, Tenn.

Second Prize, $15, B. W. Campbell, of Utica, Ohio.

Two Third Prizes, $10 each, to J. Latimer Wilson, of Nashville, Tenn., and Frank A. Doll, of Marshall, Ill.

Three of the prize-winning projects are illustrated on this page and the fourth on page 97.

Here are the four letters that accompanied the prize-winning photographs:

Automatic Phonograph

By ROY L. GERDING

Philadelphia, Tenn.

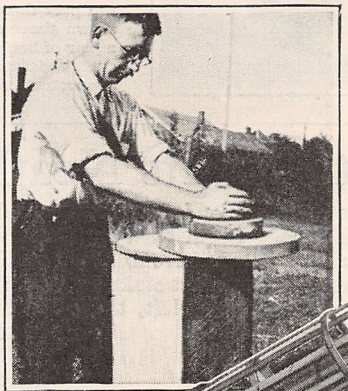
First Prize

THE accompanying photographs (above) show an automatic phonograph, run by electricity. It plays 25 disk records of any make in consecutive order without any attention whatever and plays every record to the end regardless of length. The mechanism is noiseless owing to rubber cushions and gears that run in grease. It shuts itself off when the last record is played.

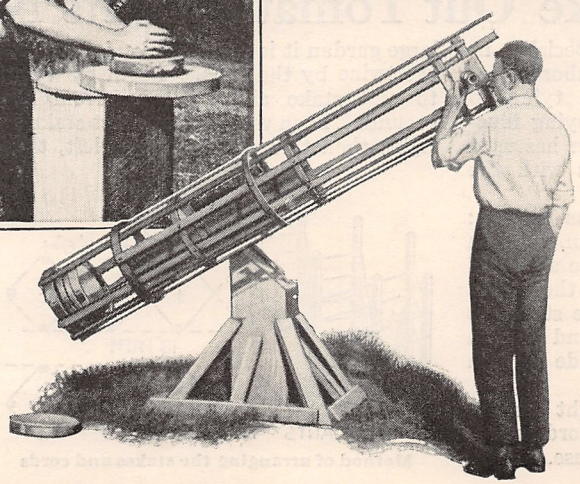
"I first conceived the idea of making such a machine about eight years ago after noting how much trouble it was to wind and change records and needles on an ordinary machine," says the inventor. "I used a carriage similar to a sawmill carriage in some respects for conveying the records from the upper receptacle to the turntable. This same carriage conveys the played record off the turntable as it is bringing on a new one. It requires about 10 seconds to change. The weight of the used records pushes down the receiving receptacle, so that each record drops only ½ in. The tone arm is raised and moved back automatically while the carriage is shifting the records.

"The cabinet is hand carved in Japanese design and is of black walnut. The floral designs stand out in high relief, while the background is carved in a sort of stucco effect. I stained the entire cabinet almost an ebony black, using some of the wood dye advertised in POPULAR SCIENCE MONTHLY, mixed with lamp black to produce the right shade. When this dried, I sanded off the high spots and re-stained the case mahogany all over. This produced a beautiful finish, the two colors blending into each other.

The floral designs are painted with artist's oil colors ranging from light pink to deep red. When these dried, I applied two coats of clear varnish of the dull variety, and waxed.



Latimer J. Wilson, third-prize winner, and his telescope with concave mirror made from ship's porthole light



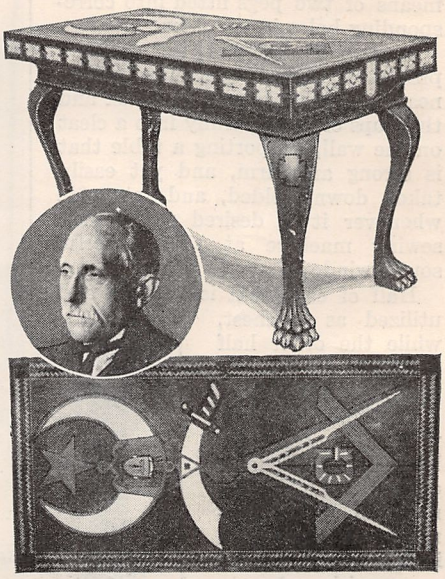


Table with inlaid Masonic emblems made by B. W. Campbell, a druggist of Utica, Ohio

Inlaid Masonic Table

By B. W. CAMPBELL

Utica, Ohio

Second Prize

I AM inclosing a set of photographs of a table made by myself (shown above). The legs are solid East India ebony with inset claws of white holly. The base of top is of Hawaiian acacia. The chain in the band around the top is of holly inlaid with ebony, set in links of Osage orange, and they in acacia.

The blocks in border around the top contain teak, primavera, ebony, rosewood, and bataan. The square and center star are padouk, a very rare wood from the East Indies. The compass is of primavera, inlaid with various woods. The "G" lining of crescent and the star in the crescent, of Osage orange; center of star, rosewood. The scimitar and crescent of holly, lined

(*Continued on page 95*)

THIS month's Home Workshop Department will be found on pages 77 to 82 and 88 to 103. The Shipshape Home on page 86, and The Better Shop Methods Department on pages 84 and 104 to 110.

Unique Folding Breakfast Nook

Can Be Converted Instantly for Sewing, Reading, or Dining

By G. E. McDonald

THIS home-built cozy corner that is alternately a dining alcove, sewing nook, and study, is the work of N. H. Paddock, a song-writer of Los Angeles, Calif.

The removable folding table is made of surfaced pine, carefully selected to get light-weight stock. In size it is 25 in. wide and 5 ft. long. It has only one floor support, the front leg, which is hinged to the table top and folds under when not in use. When in place it is held rigidly to the floor by means of two pegs fitted into corresponding holes in the floor.

A strip of ½ by ¾ in. surfaced pine about 15 in. long is nailed underneath the table top at the back and this cups or hooks firmly into a cleat on the wall, supporting a table that is strong and firm, and yet easily taken down, folded, and set aside whenever it is desired to use the sewing machine at that cheerful south window.

Half of each seat is built in and utilized as a chest, while the other half is folded up out of the way when not needed.

The table is covered with a heavy, felt-backed white oilcloth, cut to size. This does not curl at the corners. It is stenciled in blue with an enamel or varnish color to harmonize with the gray-blue walls and the indigo and gray of the linoleum.

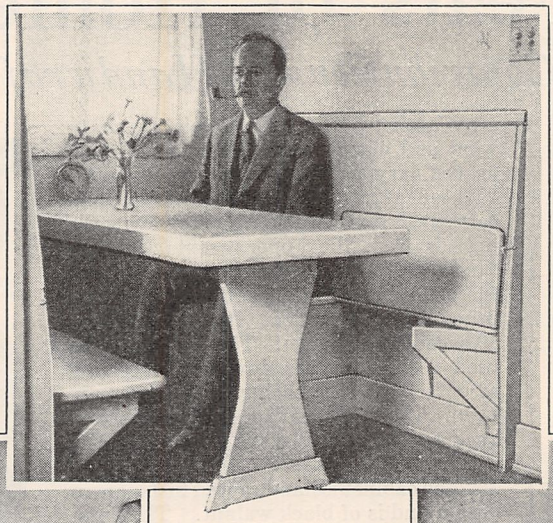
For holiday gatherings, when it is desired to seat seven or nine people, a table extension, 18 by 25 in., is brought out and clamped into place on the front end of the table.

The method of supporting the removable 18 by 25 in. extension is simple. It is fitted on the under side with two metal arms, made by Mr. Paddock from common strap iron. These are ⅛ in. thick, ¾ in. wide, and 6 in. long, and have a ¼ in. upturn or lip on the end. Between the metal straps and the board, a lath is inserted to act as a spacer.

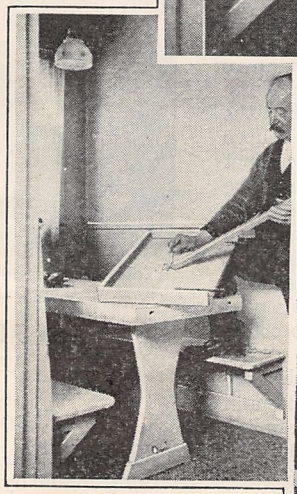
The arms enter through two holes in the end rail of the table and the upturned lips or hooks catch firmly into recesses made in the under side of the table. In regard to these recesses, their upper sides are horizontal, but the bottoms are beveled to a 45-deg. angle to enter conveniently when the board is tipped.

The extension is edged on three sides by a ¾ by 2 in. pine strip, not only for looks but to hold it firmly in place and prevent warping.

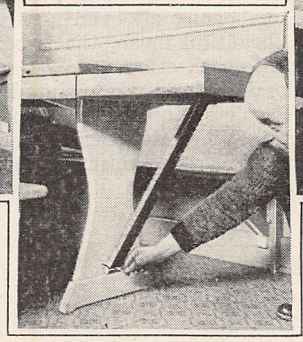
The leg, or bracket, is fastened to the extension top by a loose pin hinge, so that the two can be taken apart when not in use. The bottom of the leg is beveled and fits snugly into a small galvanized iron socket provided near the bottom of the table support. To make the fastening absolutely foolproof, a pin is inserted through the socket to hold the leg immovably in place.



A general view of the dining alcove is shown above. When not required, the outer seats and their supporting brackets are folded flat, out of the way



Fastening the supporting leg to the under side of the neat extension top (above) and pinning the lower end of the leg into its metal socket at the base (at right)



Metal arms on the extension top pass through the holes shown above and catch like a pair of hooks in recesses cut underneath, securely supporting the extension

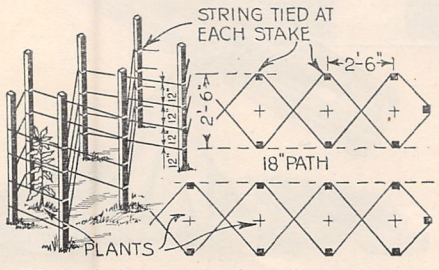
RECENTLY a friend and I repainted a skiff that had been built in 1898, but was more solid and watertight than many wooden craft made in the last five years. We traced its history to learn the builder's secret. All the cypress planks and wooden parts first were placed on trestles in the hot sun and at intervals for a week given thin coats of linseed oil until thoroughly impregnated. The few coats of paint the boat received after it had been built were sufficient to preserve it practically as good as new for a quarter of a century.—C. E. V.

How to Stake Out Tomato Plants Neatly and Quickly

IN RAISING tomatoes, especially in the home garden, much labor is required in driving stakes and tying up the branches. The accompanying illustration shows a plan the writer has used in his garden for many years with the best results.

The plants are set out as follows: Rows 48 in. apart; plants 30 in. apart in the rows. Set plants in a hole about 12 in. deep and draw in the soil as they grow. When about 18 in. high, drive stakes as indicated, one stake at each end of each row and one stake on each side of each plant.

The stakes may be any height desired; I prefer about 5½ ft. The cord used is the cotton twine that grocers use. For a large garden it is more economical to buy the twine by the cone. Begin by tying to end stake about 12 in. from the ground. Then wrap around first stake at right, then to second stake at left, then third stake at right, and so on down the row to end stake. Return to first stake on the ones that have been missed. Repeat the process backward and forward, each trip raising the string about 12 in. on the stakes.



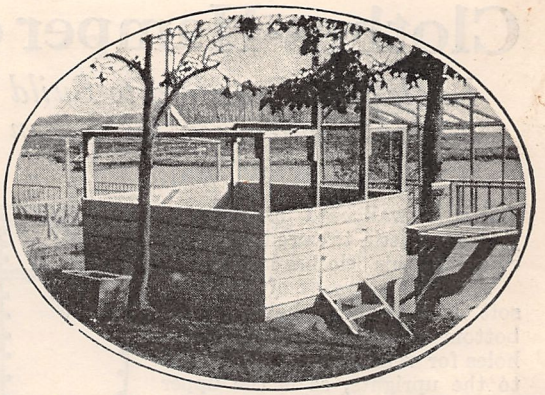
Method of arranging the stakes and cords

This may seem a big job, but when it is done no more tying is necessary. As the branches grow, simply lift them over the string, where they rest lightly and naturally with no danger of being broken, even by storms.

The best features of this arrangement are that the work can be done while the plants are small, the fruit ripens better, the garden always looks neat and trim, and the stakes may be used year after year.—C. P. MCGUIRE, Louisville, Ky.

A Tent Platform Insures Camping in Comfort

By Henry S. Laraby



When covered with canvas, this small, dry, comfortable sleeping box takes care of week-end guests

IF YOU are planning to spend your week ends and vacation in a permanent camp this year, you can insure your comfort and enjoyment by building a platform for your tent and adopting some of the conveniences illustrated in the drawings below.

Camping out is greatly on the increase. There is real zest and fun in it, and it is inexpensive enough for even a thinly lined pocketbook. Not only are the benefits of a yearly period of invigorating outdoor life now recognized universally, but the auto has banished most of the old-time difficulties of transporting camp equipment and supplies, which once deterred many from spending their summer vacation under canvas.

If you ask any one who has tried camping and given it up, what the difficulty was, you are pretty sure to hear a painful narrative about sleeping under a leaking tent, having the canvas blow down during a storm, being flooded out, or having all sorts of bugs and ants to contend with. These are the troubles of a tenderfoot. They are entirely unnecessary in any well prepared permanent camp.

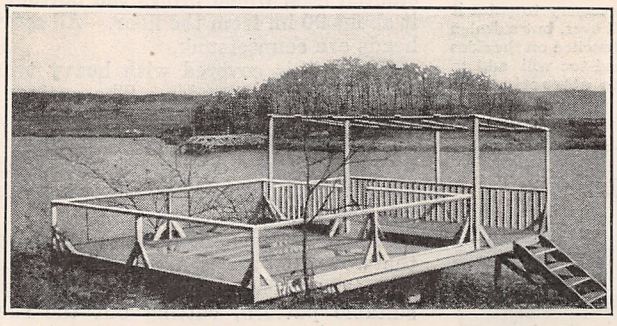
First, you must choose a good tent. Popular among campers now is the standard army pyramidal tent, 16 by 16 ft. and 11 ft. high, made of 12½-oz. duck. Used tents in guaranteed good condition can be obtained through the Boy Scouts of America and from various dealers for about $35, without pole or stakes. These tents are waterproof and require no fly, which is an extra cover commonly used over wall tents.

If you prefer a wall tent, you have an unlimited variety from which to choose. Get heavy 12-oz. canvas; the few dollars extra doesn't count in the long run—or the long rain. A 14 by 18 ft. 12-oz. tent costs about $50, and its fly, between $20 and $25. In many cases a smaller tent will be amply large enough.

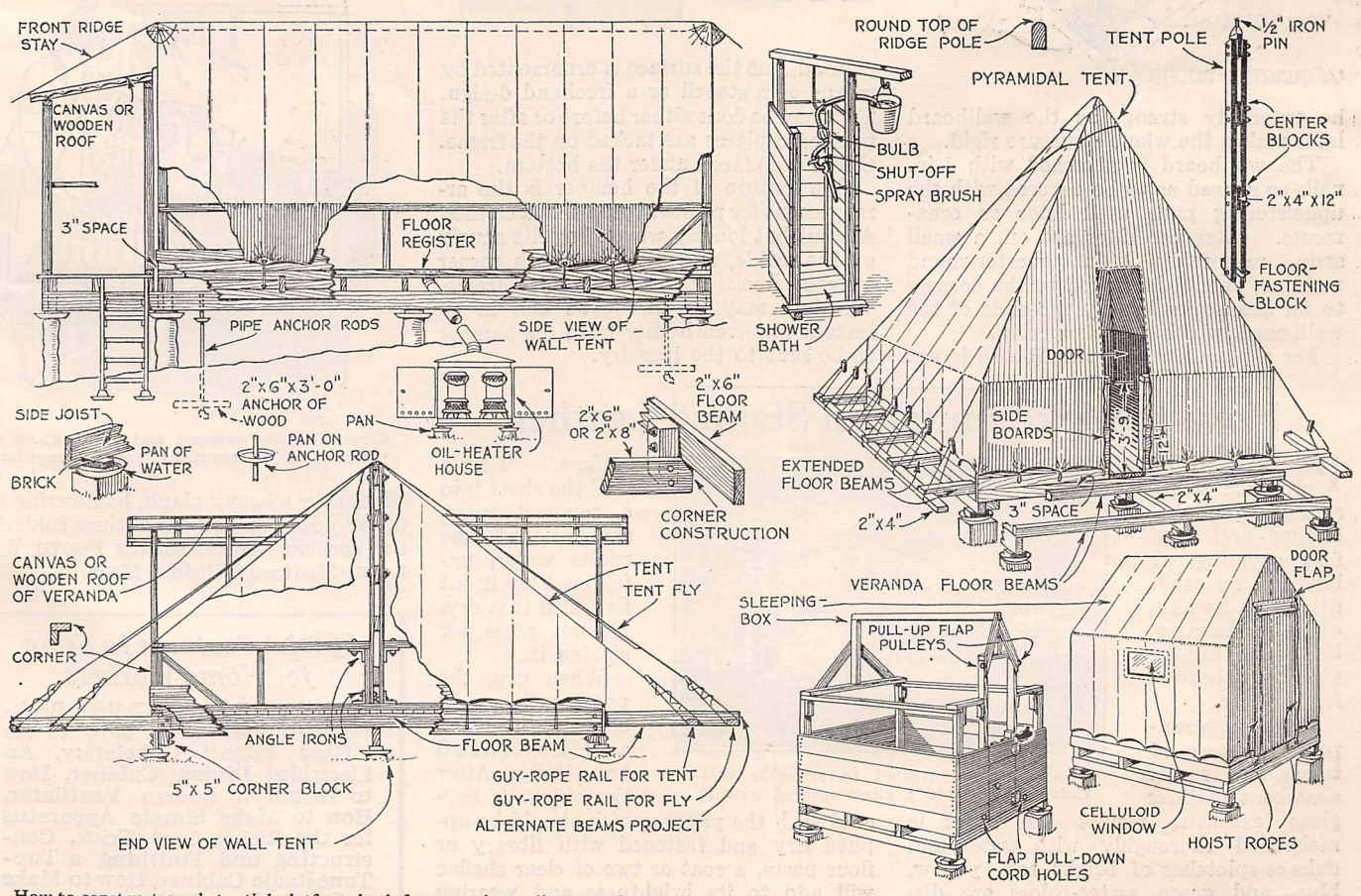
Any good tent will last for years with ordinary care. Your platform will cost about $50 to make, but if built right, it will last for at least 10 summers. The average camp site costs about $25 a season in rent, but you may be able to reach camping grounds that cost nothing or, possibly, you may have to pay a little more.

Set your tent up roughly in your backyard and with a tape line measure the length and width, the height of the side walls when the canvas is drawn tight, and how far the guy ropes extend when they are in a straight line with the roof of the tent. Then figure out how much lumber you will need, being sure to allow enough.

(Continued on page 99)



A splendidly located tent platform with a porch. It lacks, however, guy-rope rails and other improvements shown below

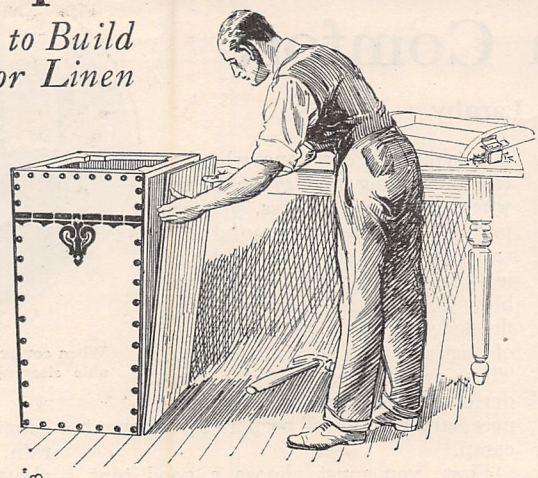


How to construct a substantial platform both for a regular wall tent and a standard army pyramidal tent. Note the pans that are filled with water to prevent crawling insects from entering the tent. Suggestions also are given for a sleeping box, a shower bath, and an oil-stove heating plant for wet, chilly days

Clothes-Hamper of Wallboard

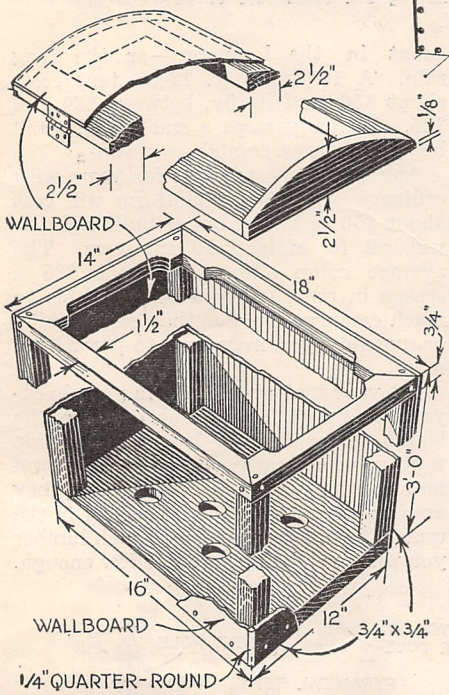
Little Skill Required to Build a Neat Container for Linen

By W. W. White



FIBER wallboard of pleasing and artistic texture is used for covering this clothes-hamper.

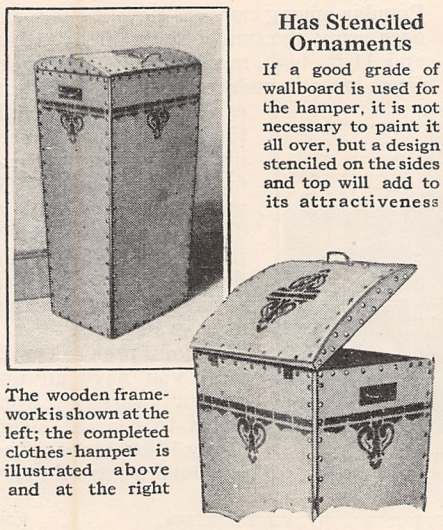
The frame is made of any light, soft wood as shown below. The bottom is one large board with holes for ventilation. It is nailed to the uprights, as is the upper frame, but the fastening need not be especially strong, as the wallboard later makes the whole structure rigid.



The wallboard is attached with 1-in. nails so spaced as to be covered with the upholstering nails used later as ornaments. After the sides are on, a small strip, preferably ¼-in. quarter-round molding, should be nailed to the corners to fill the angles left by the ends of the wallboard, which do not overlap.

For a plain finish the wallboard is not painted, but the surface is ornamented by means of a stencil or a freehand design. This may be done either before or after the wallboard pieces are tacked on the frame. Glides are placed under the bottom.

One feature of the hamper is the arrangement for removing the soiled clothes. A stout but loosely woven bag fits snugly on the inside, and a ring at each corner engages hooks under the upper frame. The bag may be unhooked and in an instant removed bodily from the hamper to be sent to the laundry.



Has Stenciled Ornaments

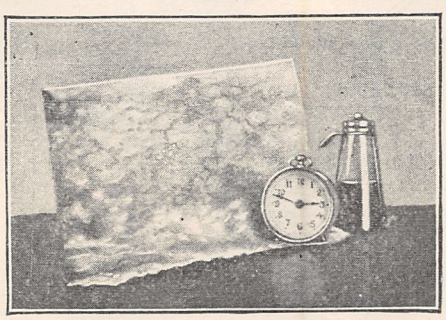
If a good grade of wallboard is used for the hamper, it is not necessary to paint it all over, but a design stenciled on the sides and top will add to its attractiveness

The wooden framework is shown at the left; the completed clothes-hamper is illustrated above and at the right

How to Make Imitation Stained Leather

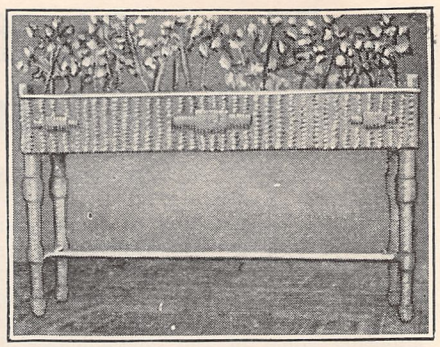
PAPER may be prepared to resemble thin tinted leather and used for covering or binding snapshot albums, books, clocks, lamps, book ends, candlesticks, picture frames, etc.

Common wrapping-paper of tough and rather absorbent qualities gives excellent results. A sheet is moistened thoroughly with water, and dabs or splotches of bright red, yellow, blue, and green water-colors are distributed irregularly over the entire surface. Then wad the sheet into a compact mass, squeeze out the excess water, unfold and lay it out flat until it is dry. Do not press nor stretch it.



Wrapping-paper treated to resemble thin tinted leather and a clock covered with it

When dry, the paper will have a crinkled texture and be tinted beautifully. After the object is covered with the paper, which should be applied dry and fastened with library or flour paste, a coat or two of clear shellac will add to its brightness and wearing qualities.—C. E. V.



Window-Box for Potted Plants Is Covered with Heavy Twine

TWINE artistically woven about a wooden framework forms this novel and decorative window basket for potted plants.

Strips of soft wood 1½ in. wide and ⅞ in. thick are fitted and securely fastened together with wood screws to serve as the box frame. The box measures 6 by 12 by 44 in. inside and is supported by four substantial legs, which brings the bottom of it about 20 in. from the floor. All screw-heads are countersunk.

The box is covered with heavy twine woven over and under. The surface is relieved in places with a design worked out in finer twine. Heavy twine also is wrapped closely around the legs. The twine should be covered with two protective coats of varnish.

Inside the box, fitting closely against the woven twine, is a galvanized sheet-iron tray. This is made by drawing a suitable pattern, cutting out the sheet metal with tinner's shears, bending the edges over a heavy plank, hammering the upper edges smooth and then soldering the corners.—MRS. EDWIN FOOTE WILLARD, Medford Hillside, Mass.

Common twine wrapped and woven about a wooden form, covers this attractive flower-box

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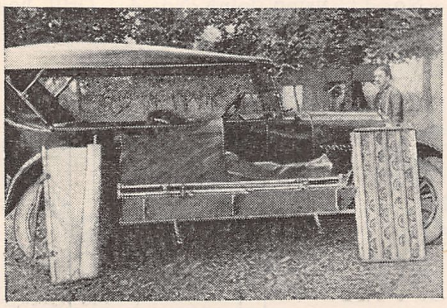
Cheaply Built Equipment for Camping Tours

By J. T. Garver

AFTER an all-day auto run through delightful scenery, the autoist is tired. It is getting dark. Despite unfamiliar terrain, inhospitable fences, farmers and farmer's dogs, he must camp somewhere. And camp-making with a complicated, ill-appointed outfit is a dispiriting task.

How much better is it to start on a trip with an outfit that provides a readily accessible place for everything you wish to carry! Such an outfit is illustrated.

The equipment was constructed by A. B. Hostettler, a retired oil man of West Salem, Ohio, for his use on yearly trips to Florida. Built on the running-board, it carries every necessary item, including provisions, refrigerator, high-pressure tank and stove, and a real bed.



It leaves all four doors of the car unobstructed and does not ruin the appearance of the car or mar the finest finish. It can be removed completely in five minutes.

The left-hand runningboard cabinet, shown in Fig. 1, below, is made of ¾-in. poplar. It is 6 ft. 1½ in. and 5 ft. 9½ in. long at top and bottom respectively, 7½ in. high and 13 in. wide. All joints are fastened with 2½-in. screws.

The refrigerator is the conventional nursery style, made of double-walled zinc, 11 in. wide, 12 in. high and 16 in. long. It is held in place by cleats and straps.

The two-leaf folding table forms a lid for the provision and dish compartment when closed and is held in the extended position by a wood prop with hinges at each end. The pins are driven from the hinges and removable cotter-pins used instead.

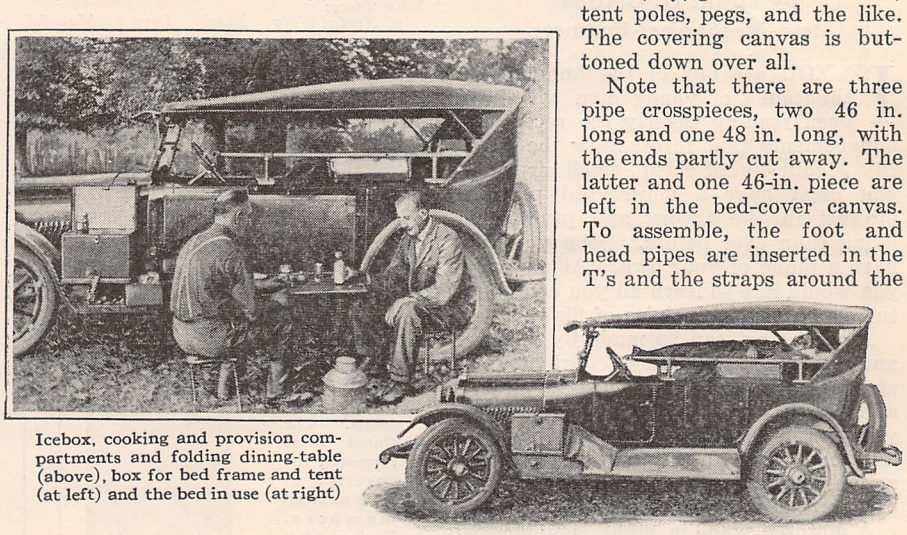
Heavy canvas, which is tacked to the back, is fastened down over the packed outfit to exclude dust and rain, and when camp is made, is fastened up, out of the way, with the car curtain fasteners.

The cabinet is fastened securely to the runningboard with two bolts extending through angle brackets and held with wingnuts.

As the tanks usually supplied with pressure stoves are small, a larger one, 10 in. high and 7 in. in diameter, with a gage and flexible copper tube is provided. When in use, the stove rests upon the stove compartment lid.

A good bed is the best appetizer the wayfarer can strap to the runningboard. Mr. Hostettler's bed, shown in detail in Fig. 2, requires ¾-in. threaded galvanized pipe cut to the dimensions given, 8 pipe T's, springs, cotter-pins, canvas, and straps. The threads of four of the T's are reamed out to take the two 46-in. end pieces in slip-joint fashion.

The construction of the auxiliary cushion is shown in the photograph at the left. It is fastened to the side rails with clips, springs and hooks. When not in use it packs into the bottom of the tonneau.



Icebox, cooking and provision compartments and folding dining-table (above), box for bed frame and tent (at left) and the bed in use (at right)

The bed cover is heavy, double thick, well stitched canvas with tubular ends. The bed is carried on the right runningboard rack, the dimensions of which are shown in Fig. 3. The side rails and short leg pieces are left screwed together, the end T's slipping over round wooden posts, which are bolted to the end brace irons as indicated. This leaves plenty of room in the rack for tent, fly, grease and oil cans, tent poles, pegs, and the like. The covering canvas is buttoned down over all.

Note that there are three pipe crosspieces, two 46 in. long and one 48 in. long, with the ends partly cut away. The latter and one 46-in. piece are left in the bed-cover canvas. To assemble, the foot and head pipes are inserted in the T's and the straps around the 48-in. long sliding crosspiece are pulled as taut as possible.

When used in the car, the bed legs rest upon two 4 by 50 in. boards, which are carried for the purpose. When used in the tent, 14-in. pipe legs are screwed in. An extra bed may be carried in the rack to accommodate a party of four. The bedding is carried in the tonneau.

In case of inclement weather and skiddy roads, Mr. Hostettler plays safe and makes a permanent camp. A fly is used over the small tent and car and forms a sort of roomy porch under which the cooking may be done. The camp is illuminated at night by an adjustable spotlight.

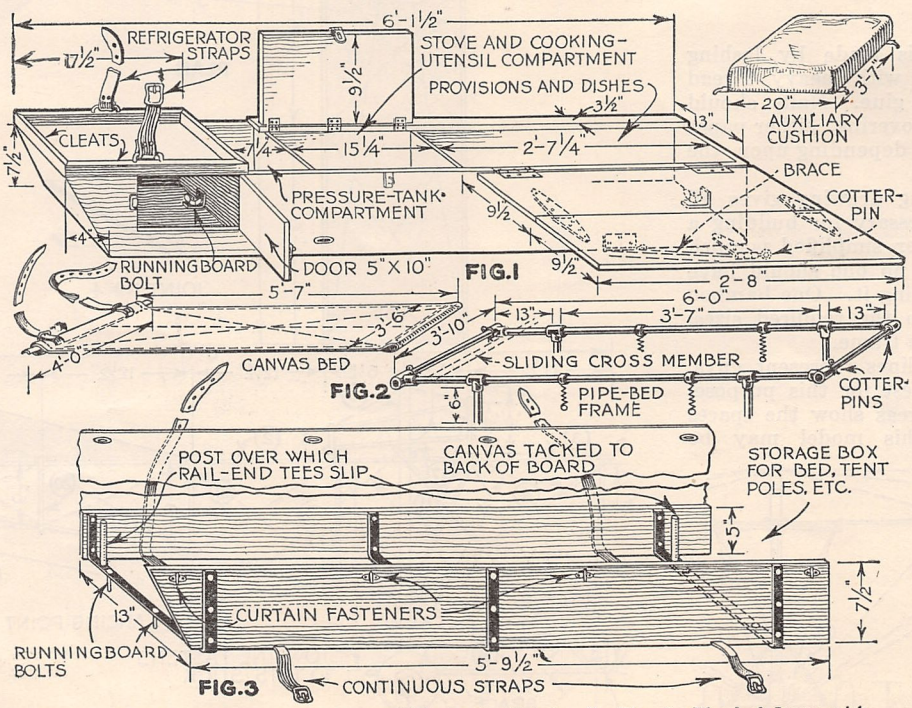


Fig. 1—Left-hand runningboard box, which is the "kitchen." Fig. 2—The bed frame with springs for auxiliary cushion, and canvas bed cover. Fig. 3—Rack for right-hand runningboard

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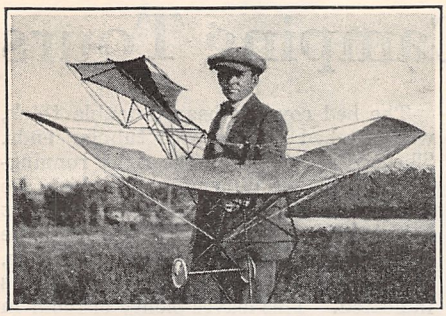
HOME movies sometimes are hazy and flat looking because they are not projected on a suitable screen. To make a satisfactory screen, cut a piece of sheeting cotton 3 by 4 ft., or whatever size is needed, give it a coating of shellac, and at the same time, before the shellac dries, cover it fairly thickly with powdered chalk. You will find that a picture projected on this surface will stand out with great brilliance and definition.— GUY E. MCALLAN.

One Bamboo Fishing-Pole Provides Frame for Unique Glider Model



By Edwin G. Gettins
Aero-Mechanical Engineer

IF YOU are one of the hundreds of thousands of young men who have been reading eagerly the recent announcements that foreshadow the quantity production of cheap, small airplanes, you must have a more vital personal interest in the theory and practice of flying than ever before. Soon you may have a plane of your own. At any rate, you would like to learn all you can about the elementary principles of flight.

A good start can be made by building and flying a model glider. Gravity and air currents alone influence a glider's actions. By observing a glider's flights, you can learn exactly how a plane is affected by air currents and winds. The action is the same on full-sized planes, except that it cannot be detected.

A motored plane in flight is influenced so powerfully by its motor that it appears to be slipping smoothly through the air when really it is plunging about in a manner that is far from smooth. In a glider the action is many times slower and can be detected from the ground as well as from the machine if of man-carrying size.

Split bamboo is the best material for the frame of a model glider, being light, tough, and flexible. After being heated over a gas flame it can be formed with the hand into any kind of bend. Spruce may be used, but it has less than one-sixth the strength of bamboo.

THE best joint is made by lashing pieces together with heavy thread and painting with glue. Nails should not be used. For covering, either paper or cloth will serve, depending upon the model's size.

The accompanying drawing gives all the dimensions necessary for building a 6-ft. monoplane glider, simplified as much as possible so that no one should have difficulty in assembling it. One bamboo fishing-pole, split to the required sizes, will make the entire frame.

The heavy dash lines represent guys. Light fish cord is best for this purpose. The light shaded areas show the spaces to be covered. This model may be covered with cloth or heavy wrapping paper. The body may be covered also, if desired. The wings must be guyed in the bowed position shown, so that the plane will not tip over sideways.

The following list gives the size, length, and number of sticks required in the structure. All dimensions are in inches.

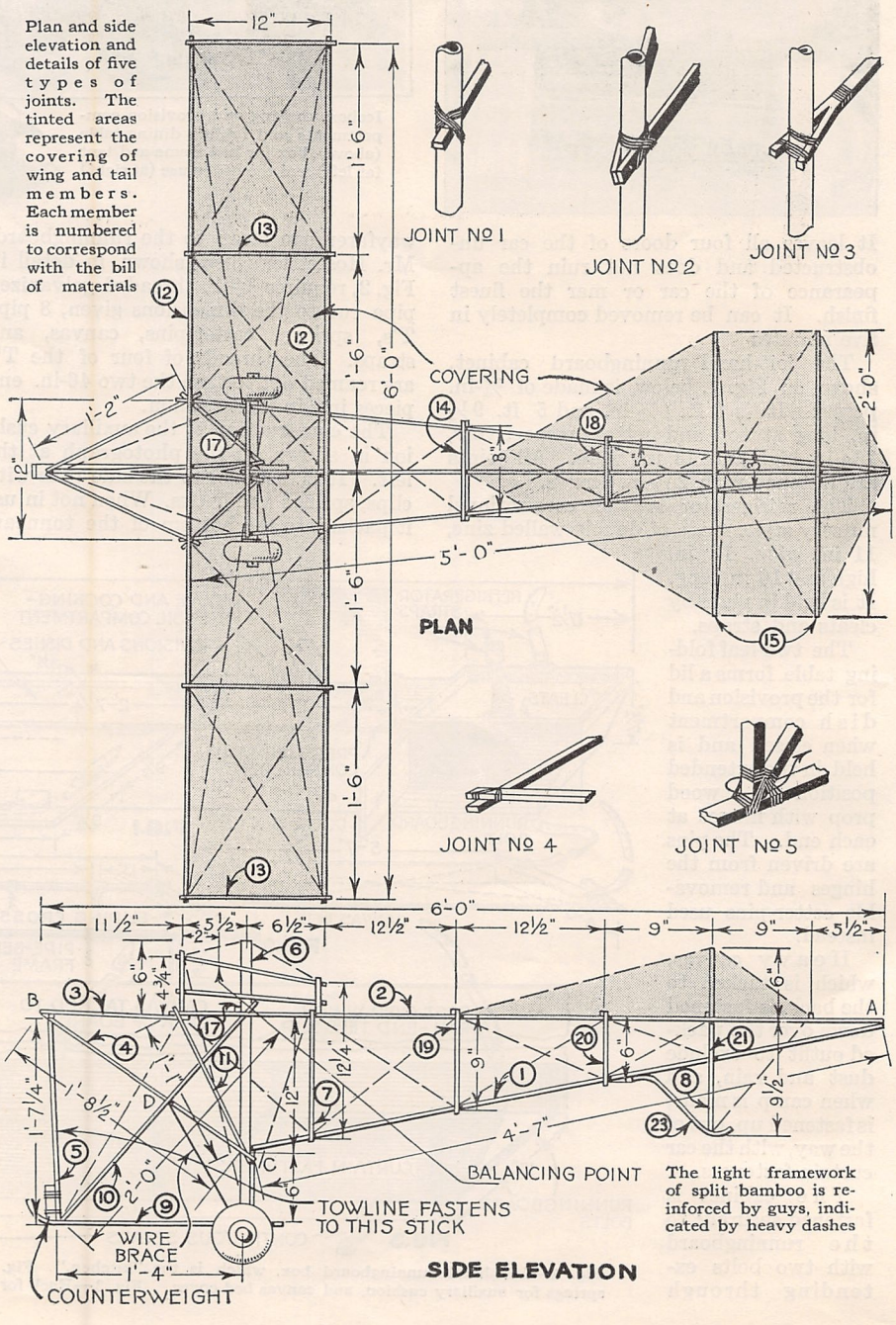
Stick No.	Pieces Needed	Wide	Thick	Long	Material
1	1	1/4	1/8	56 1/4	Split bamboo
2	2	1/2	1/8	60 1/4	" "
3	2	1/2	1/8	14 1/2	" "
4	1	1/2	1/8	23	" "
5	1	1/2	3/16	19 1/4	" "
6	1	1 in. diameter		24	Round bamboo
7	2	1/4	1/8	12 3/4	Split bamboo
8	1	1/4	1/8	15 1/2	" "
9	1	5/8	3/16	23	" "
10	1	1/2	3/16	25	" "
11	2	1/2	1/8	15 3/8	" "
12	2	1/2	1/8	72 1/2	" "
13	4	3/8	1/8	12 1/2	" "
14	1	1/4	1/8	8 1/2	" "
15	2	1/4	1/8	24	" "
16	1	3/4 in. diameter		15 1/4	Maple dowel
17	1	1/2	3/16	11 1/2	Split bamboo
18	1	1/4	1/8	5 1/2	Split bamboo
19	2	1/4	1/8	9 1/2	" "
20	2	1/4	1/8	6 1/2	" "
21	1	1/4	1/8	13	" "
22	2	1/4	1/8	8	" "
23	1	3/16	1/8	15	" "

You will notice that the plan dimensions are shorter than the length given to the corresponding stick in this bill of materials. The extra length is allowed for joints made as shown in the joint details.

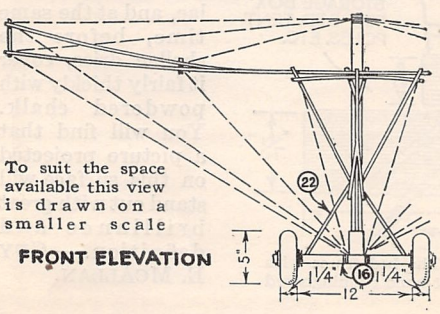
Begin the assembling by fastening the two No. 2 sticks together at *A*; then put in stick No. 17, using joint No. 4, and put in Nos. 14 and 18. Next, fasten stick No. 1 to stick No. 2 at *A*. Put in Nos. 7, 19, and 20. Then fasten stick No. 6 to No. 17, using joint No. 4. Drill hole through No. 17 for stick No. 1 and force it

(Continued on page 101)

Plan and side elevation and details of five types of joints. The tinted areas represent the covering of wing and tail members. Each member is numbered to correspond with the bill of materials



The light framework of split bamboo is reinforced by guys, indicated by heavy dashes



To suit the space available this view is drawn on a smaller scale

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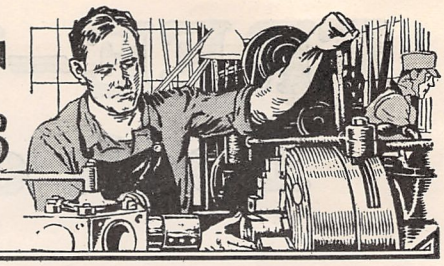
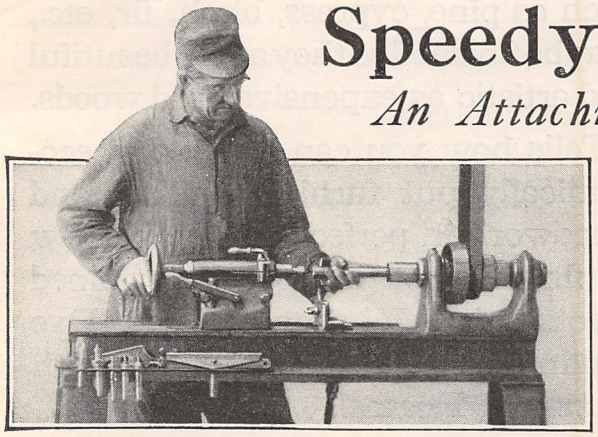


Speedy Centering Machine

An Attachment for Small Lathe Built for $15



When pressure is put on the center drill, the work revolves and the center hole is drilled and countersunk rapidly

By Edwin Kilburn

Machine-Shop Superintendent

CENTERING round stock preparatory to machining it in a lathe is a somewhat tedious process unless a centering machine is available. The accompanying illustrations show how a speed lathe is adapted for this work and the attachments that are used.

The cost of fitting up a machine of this kind is small, but cuts down greatly the time spent on what is a purely routine operation and, of course, saves correspondingly in time and labor.

To fit the lathe for centering, a piece of 2¼-in. steel shafting is threaded on one end to fit the thread of the spindle. The other end of the shafting is bored with an included taper of 60 deg., a large diameter of 2⅛ in., and a small diameter of 7/32 in.

The V-rest shown is made from a piece of 2-in. angle iron cut 1 in. long and welded to a piece of flat steel 3 in. long. The flat piece is attached by means of a cap screw to an upright piece of flat steel, which is welded to a piece of 2-in. angle iron 4 in. long, one side of the angle piece being reduced to ¾ in. in width. The two flat pieces are of ¼ by 1½ in. stock.

The V-rest and the attached pieces (including the angle piece just mentioned) are fastened to a piece of 2-in. angle stock 4 in. long, which forms the base of the device by means of a thumb-screw working in a slot. This permits the V-rest to be adjusted toward or away from the lathe center line as desired. The whole rest assembly is attached to the lathe bed by means of the usual rest clamping bolt and handle.

The illustration above shows the device in use. The piece to be centered is located with one end in the revolving angle chuck The other end is held in the V-rest, which is adjusted to bring the shaft center approximately in line with the center drill. The drill is carried in a chuck of any suitable kind in the tailstock.

As soon as pressure is put upon the center drill the piece begins to revolve and the center is very rapidly drilled and countersunk. Releasing the pressure on the center drill causes the piece to stop revolving and it drops out when the drill is clear. Then it is changed immediately end for end without stopping the lathe.

With the V-rest properly set, the stock is centered practically dead true, and on duplicate work the speed is astonishing to one not accustomed to using such a device.

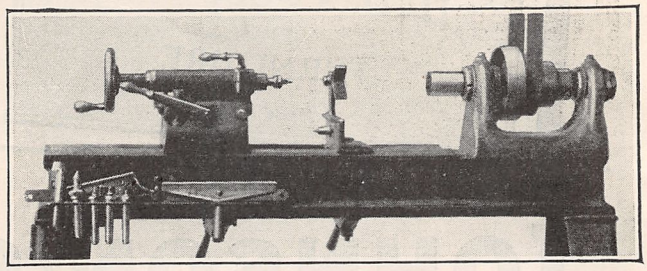
The centering machine has a capacity of from 2 to 24 in. in length and up to 2 in. in diameter. To convert the lathe, which was already in the shop, for centering purposes cost not more than $15. The attachment does not, of course, detract in any way from the usefulness of the lathe for other work.

In connection with the centering machine, and, for that matter, for any centering work, combination center drills and countersinks are extremely useful tools. They often are placed in a drill chuck when used, but that requires a certain amount of time to make ready.

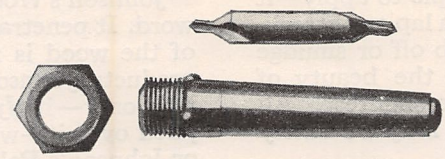
The illustrations at the bottom of the page show a set of chucks which the writer designed to use with the centering machine. They provide center drills always ready for use. It is obvious they can be used with any method of centering.

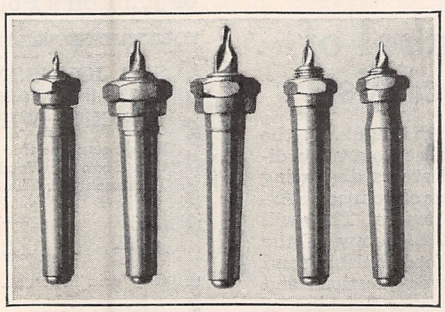
Five sizes were made as shown to accommodate five sizes of drills. The view of the disassembled chuck shows the construction quite clearly and with a few words of explanation will indicate in detail how the set may be made.

The shanks all are finished to a No. 2 Morse taper, which fits the centering machine tailstock. Each chuck body is drilled to accommodate the size center drill to be used in it. Three holes are drilled from the outside at equidistant points to receive ¼-in. steel balls. These holes should be drilled clear into the center hole if the center hole is smaller than ¼ in., but if larger, the ¼-in. holes should be left with a slight shoulder to prevent the balls from falling into the center hole. The holes should be slightly upset at the outer ends after the balls are inserted, to prevent the balls from falling out of the body.



Speed lathe with attachment consisting of tapered chuck and V-rest for centering round work automatically. Combination center drills held in special chucks are used in the tailstock





A disassembled center-drill chuck and set of five combination center drills ready for use

The body of the chuck is threaded as shown, clear to the three ¼-in. holes. A hexagon nut is fitted and taper bored for about half its length to an included angle of 40 deg., the bore being made of such size that the nut will fit over the balls to about ⅛ in. from the end of the taper when the center drill is in position.

It will be seen that when the center drill is placed in position and the nut tightened, the three balls are brought firmly against the body of the drill and hold it firmly in the chuck.

The chuck body and nut should be case-hardened. Although they may be used without doing this, they would not be so durable.

This makes a very inexpensive chuck for centering purposes and one very convenient in use.

MANY time-saving shop ideas are contained in the continuation of the Better Shop Methods Department, which you will find on pages 104 to 110.

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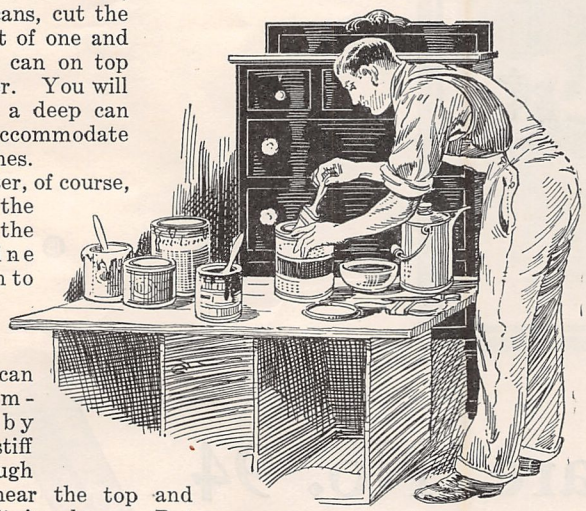
The Shipshape Home

Keeping paint brushes in good condition—Mixing and tinting paints—Fixing drain-pipe leaks

Hints on Home Painting

When the home painter has his paint "setting round" so he can do a little at a time, he is apt to have trouble with his brushes getting dry, and also with his paint "skinning over."

To keep brushes from getting dry is a simple matter. If they are small, get a snap-top gallon can; pour in enough turpentine to cover the bristles; put in the brushes and press the cover in tight. The brushes may be kept that way indefinitely, as the turpentine cannot evaporate. If a brush is a little too long, cut enough off the end of the handle so that the top will snap in tight. If the brushes are large, the gallon can will not be deep enough. In that case, take two cans, cut the bottom out of one and solder one can on top of the other. You will then have a deep can that will accommodate large brushes.



It is better, of course, to suspend the brushes in the turpentine rather than to let them stand on the bristles. This can be accomplished by running a stiff wire through the can near the top and soldering it in place. Put small hooks in the brush handles and hang them on the wire.

Either large or small brushes may be kept temporarily in a can of water, although many experts claim that water softens the bristles and is not to be recommended as a brush keeper under any circumstances. It is true that many brushes are ruined by setting them away "temporarily" in a can of water, and leaving them permanently. They are forgotten, the water evaporates, and the brush dries up hard. Brushes that have been allowed to get dry, if not too hard, may be cleaned by soaking in a strong solution of sal soda and soap, working the brush at frequent intervals.

It takes but a few minutes to clean a brush when the paint is still fresh. Wet it well with either turpentine, kerosene or gasoline and brush it out on an old board. Dip it in water and brush on a cake of yellow laundry soap, repeating this until the lather is free from color. Rinse out and let dry.

To keep the paint from "skinning over" requires only a little care. If you did not buy the paint in a snap-top can, get one and pour the paint into it. When ready to put the paint away, carefully pour a little turpentine into the paint can, but do not stir or shake it. The turpentine will float on top of the oil and keep it from drying, and being in a tight can the turpentine will not evaporate. When the paint again is used, the small amount of turpentine may be stirred in with no damage to the paint, or dipped out if you do not think the paint will stand further thinning. This method of keeping paint in condition is especially necessary when flat drying inside paints or enamel undercoaters are being used, as many of them dry very rapidly after the can is opened.

If the home painter uses ready mixed paint for inside work, add enough turpentine so that it will spread easily; if for outside work, use raw linseed oil and, if necessary, a little turpentine.

It often is impossible to buy the desired shade in ready mixed paints. If you wish to change the shade, or to make a shade to suit by using white paint as a base, get some dry paint or pigment that will produce the color wanted. Put some of the dry pigment in a small tin can and mix up thinly with turpentine. Shake the mixture round and round in the can, and then strain it into the paint through some rather coarse cheesecloth.

When color is to be added to white paint, the white should not be thinned with turpentine before the color is added, as enough turpentine will be added with the color. If the paint is too thick to spread well after the color is stirred in, more oil or turpentine may be added.

If it is desired to mix dry color with oil, wet it first with turpentine and then add the oil.

Very pleasing shades, ranging all the way from a soft ivory down to soft shades of fawn and brown, can be made by mixing varying amounts of yellow ochre and burnt umber with a white base, in the proportion of three parts of ochre to one of umber. If the colors are mixed by weight, the shades may be matched perfectly at any time, without guesswork.

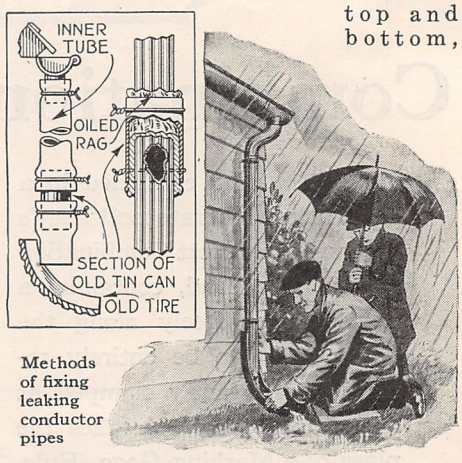
Three ounces of ochre and one ounce of burnt umber added to one gallon of white paint make a beautiful old ivory tint for either inside or outside work. As a trim for this on outside work, 9 oz. of ochre and 3 oz. of umber to the gallon give a pleasing contrast.

If the painter chooses to use white lead ground in oil as a base (or a mixture of white lead and zinc), it should be mixed with linseed oil, adding but a small quantity of oil at a time and stirring until smooth before adding more. If for outside work, use raw oil, but if for inside work use either boiled oil or what is known as flatting oil. Stir in enough oil to make a fairly thin paint and then add sufficient turpentine to make it spread well. If for inside work the addition of a small amount of litharge will make it dry quicker. Litharge lumps very badly, and must be mixed into a paste with a little of the paint, and rubbed out smooth on a slab with a putty knife, before putting it into the paint.—J. H. Downie.

Conductor-Pipe Repairs

Are the eave troughs and conductor pipes of your house in good repair for heavy rains? If you neglect to fix leaky drainpipes, you are almost certain to have costly carpenter and painter, if not mason, bills to pay in the long run.

If the conductor pipe has rusted through and allows water to shoot out of its side, you can repair it with a tin can of suitable size. Cut out the top and bottom,



Methods of fixing leaking conductor pipes

slit the resulting cylinder open, plug and cover the hole with an oiled rag, and slip the tin around it and the pipe. Bind tightly with a piece of wire. This repair will stop the leak, and the oil on the rag will tend to prevent the hole from rusting.

In case the drainpipe is beyond repair, a substitute one made of old automobile inner tubes can be used until another is obtained. The illustration plainly shows how tins serve to connect lengths of tubes.

Note also how the writer uses a section of cast-off tire to carry the drain water away from the sill of the building.—C. W.

Try this Yardstick on YOUR Brain

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2. Are the stars solid like the earth?
3. How was the earth formed?
4. Why is glass transparent?
5. How do we know that the earth is slowly shrinking?
6. What is an electric current?
7. How was petroleum formed?
8. Do electrons really move through wire when an electric current is flowing through it?
9. What physical changes in your body are produced by fear?
10. How do muscles exert power?
11. What are X-rays?
12. Can we see atoms with a microscope?
13. Why does heat expand things and cold contract them?
14. Why does the moon appear to change its shape from time to time?
15. What is the brain made of?
16. Why is it possible that the inside of the earth is growing hotter instead of colder?
17. Why is frost more likely on a clear night than on a cloudy one?
18. Does thinking use up the thinker's energy?
19. Which travels faster, electricity or light?
20. What simple test will distinguish wool from cotton?
21. What makes the noise of thunder?
22. Why would men ultimately suffocate if all the green plants were killed?
23. Does the boiling of water remove the impurities in it?
24. How do the living cells of the body get the energy with which to do their work?
25. How is the speed of light measured?

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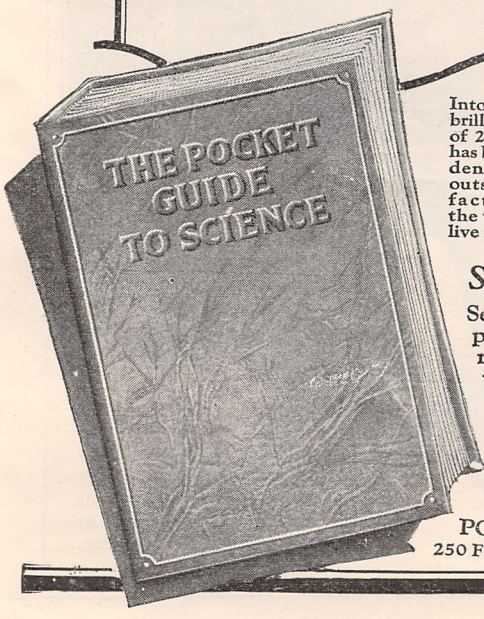

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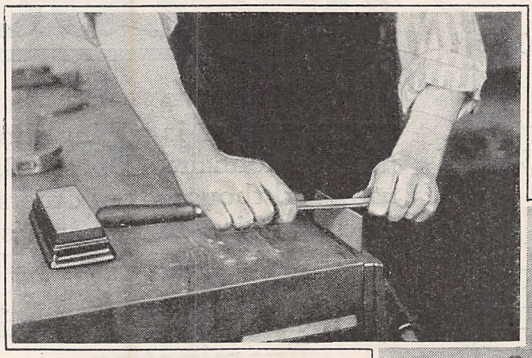
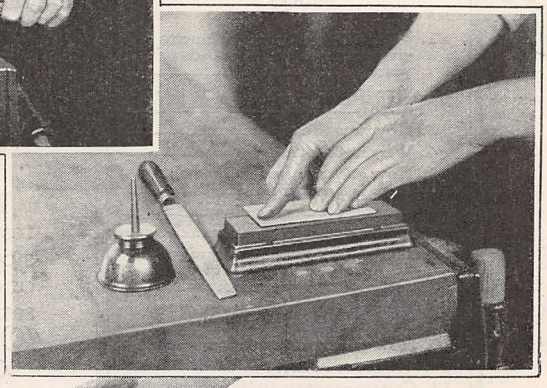
The Home Workshop

How to Sharpen Your Scraper

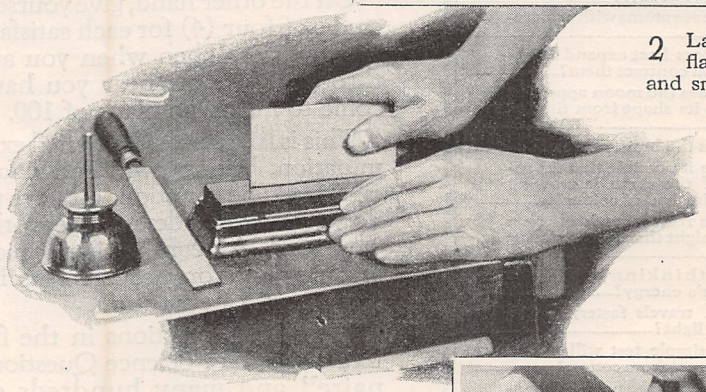
Putting a keen edge on the simplest of wood-working tools

By Emanuel E. Ericson



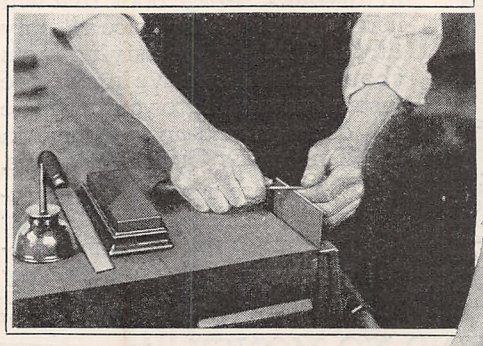


1 First "draw-file" the scraper. The stroke is taken horizontally away from the worker and the file is lifted when pulled back. Continue until there is a burr on the cutting edges. These instructions apply to square-edged scrapers

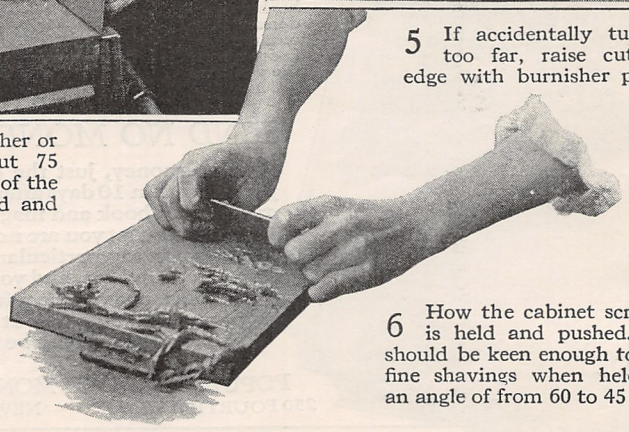


2 Lay the scraper flat on an oilstone and smooth it. Use a fine stone and one that is straight on the surface. Do not lift the outer edge of the scraper while doing this

3 Alternate between this position and that shown in Fig. 2 until the burr or wire edge is removed. A square piece of wood placed against the steel blade will aid you to hold the scraper upright



5 If accidentally turned too far, raise cutting edge with burnisher point



4 Hold the burnisher or nailset at about 75 deg. to the flat side of the scraper. Press hard and push away from you. One firm stroke should be sufficient. A beveled scraper is sharpened first like a chisel and then the edge turned similarly

6 How the cabinet scraper is held and pushed. It should be keen enough to cut fine shavings when held at an angle of from 60 to 45 deg.

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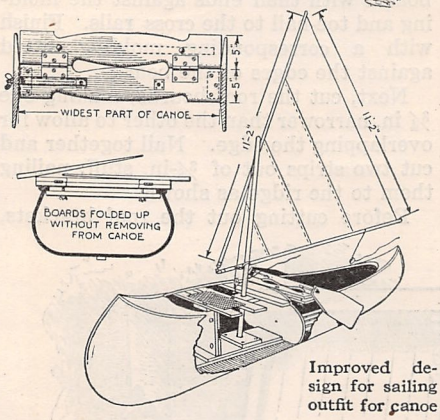
The Home Workshop

Blueprint Shows How to Make a Canoe Sailing Outfit

If you wish to rig your canoe for sailing, you should make use of Home Workshop Blueprint No. 25



Improved design for sailing outfit for canoe

WORKING details and complete bill of materials for this canoe sailing outfit will be found in Blueprint No. 25 listed below.

Complete List of Blueprints

ANY one of the blueprints listed below can be obtained from POPULAR SCIENCE MONTHLY for 25 cents. The Editor will be glad to answer any specific questions relative to tools, material, or equipment.

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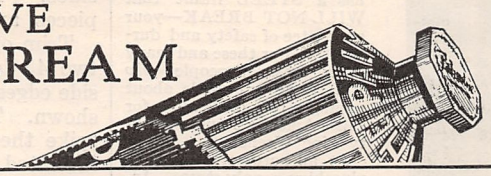
No irritation. The palm and olive oil content leaves the face in fine condition.

Let this test prove that we have secured these wanted effects—as no one else has done. Do this in fairness to yourself and us. Clip coupon now.

To add the final touch to shaving luxury, we have created Palmolive After Shaving Talc—especially for men. Doesn't show. Leaves the skin smooth and fresh, and gives that well-groomed look. Try the sample we are sending free with the tube of Shaving Cream. There are new delights here for every man who shaves. Please let us prove them to you.

THE PALMOLIVE COMPANY (Del. Corp.), Chicago, Ill.

PALMOLIVE SHAVING CREAM



10 SHAVES FREE and a can of Palmolive After Shaving Talc

Simply insert your name and address and mail to Dept. B-1023, The Palmolive Company (Del. Corp.), 3702 Iron Street, Chicago, Ill.

Residents of Wisconsin should address The Palmolive Company (Wis. Corp.), Milwaukee, Wis.

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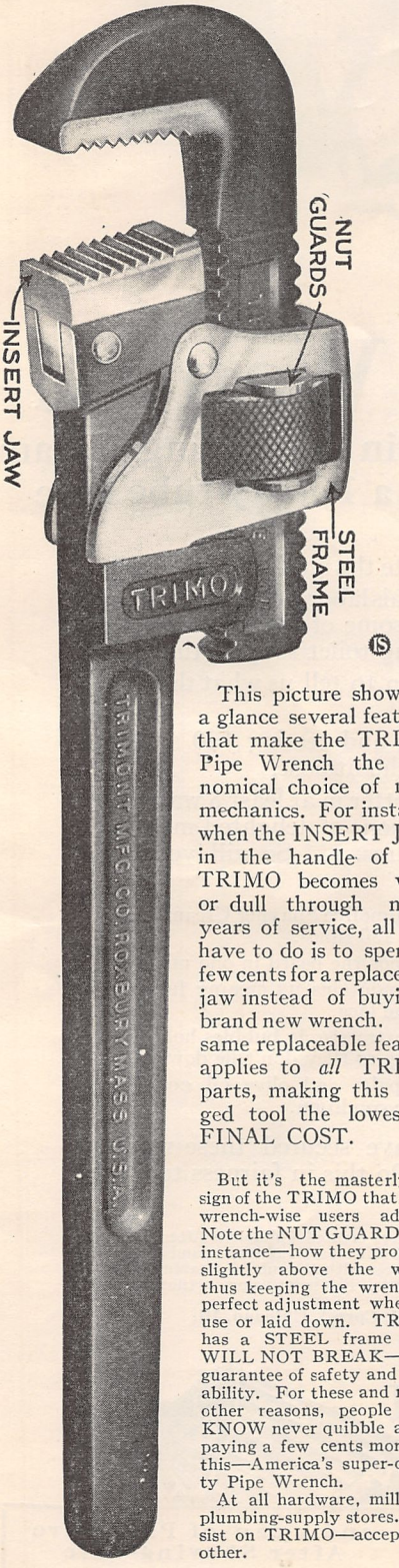
TRIMO
Economy



This picture shows at a glance several features that make the TRIMO Pipe Wrench the economical choice of most mechanics. For instance when the INSERT JAW in the handle of the TRIMO becomes worn or dull through many years of service, all you have to do is to spend a few cents for a replaceable jaw instead of buying a brand new wrench. This same replaceable feature applies to *all* TRIMO parts, making this rugged tool the lowest in FINAL COST.

But it's the masterly design of the TRIMO that most wrench-wise users admire. Note the NUT GUARDS, for instance—how they protrude slightly above the wheel, thus keeping the wrench in perfect adjustment when in use or laid down. TRIMO has a STEEL frame that WILL NOT BREAK—your guarantee of safety and durability. For these and many other reasons, people *who* KNOW never quibble about paying a few cents more for this—America's super-quality Pipe Wrench.

At all hardware, mill, and plumbing-supply stores. Insist on TRIMO—accept no other.

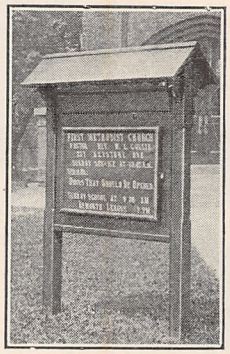
TRIMONT MFG. CO.
ROXBURY, MASS.
America's Leading Wrench Makers for Nearly Forty Years.

The Home Workshop

Community Bulletin Board

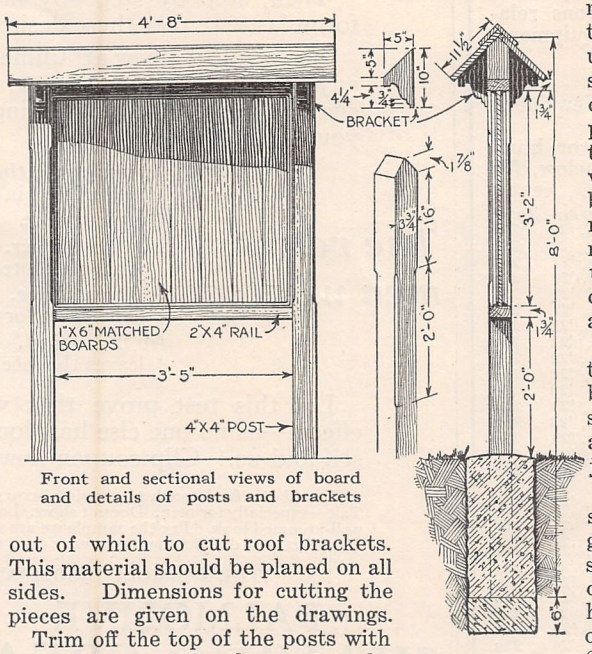
For Displaying Notices of Town, Club, School, and Church Affairs

By A. Neely Hall, *Handicraft Specialist*



FOR announcements of town, club, church, and school affairs, an outdoor bulletin board is essential. One of the neatest designs for such a board is illustrated. If a frame with adjustable letters is used for the standing announcements, it may be hung upon one side of the board, as shown, and other announcements, invitations, programs, and notices tacked to the opposite side.

Cypress or other weather-resisting wood should be used. Two 4 by 4 in. posts 8 ft. long are needed for the end supports, a "two by four" for the cross rails, 1 by 6 in. matched boards for the panel, and a molding to run around its edges, a 12-in. board and a strip ⅜ in. thick for the roof, and a piece of "two by six" out of which to cut roof brackets. This material should be planed on all sides. Dimensions for cutting the pieces are given on the drawings.



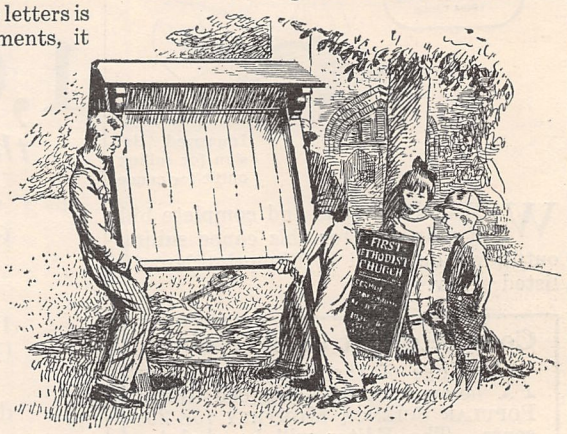
Front and sectional views of board and details of posts and brackets

Trim off the top of the posts with two 45-deg. cuts, and chamfer the side edges for a distance of 24 in. where shown. Then cut the two cross rails and spike them to the posts at the heights indicated. The bulletin board illustrated in the photograph has a recessed panel near the top and a flush panel below it, but this is unnecessary, as a very good panel can be built up of the matched boards specified above.

To fasten the panel boards in place, first nail a cove or quarter-round molding around the opening, then place the boards with their ends against the molding and toe-nail to the cross rails. Finish with a corresponding molding fitted against the edges of the boards.

Next, cut the roof boards, making one ¾ in. narrower than the other to allow for overlapping the edge. Nail together and cut two strips out of ⅜-in. stuff, nailing them to the ridge as shown.

Before cutting out the roof brackets,



make a cardboard pattern so that all the brackets will be uniform. Have them bandsawed at a woodworking mill or cut out on a power fretsaw, if possible. If you wish to cut them with a hand fretsaw, it would be well to saw eight brackets out of ⅞-in. stock and nail them together in pairs rather than to attempt to saw the heavier stock. The profile can be finished with rasp, file, and sandpaper.

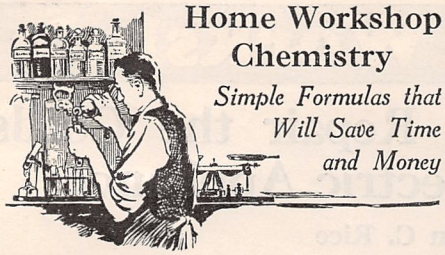
Creosote stain gives an attractive finish to the bulletin board, although any shingle stain will serve the purpose, and of course a two-coat paint job can be substituted.

Posts 8 ft. long permit setting the ends 2 ft. into the ground, which is ample for support if the ground is packed down firmly. The best means, however, is to dig holes 12 in. or so in diameter, 30 in. deep, fill with concrete to a depth of 6 in., then when this has set, stand the posts upon these footings and fill concrete around the posts to the surface level.

Likes Model-Making Articles

IN MY estimation your articles on a model railway in POPULAR SCIENCE MONTHLY are a pretty fine piece of work. I always wanted to build a model railway and with your simple instructions it is a cinch to make one.—H. D., Brooklyn, N. Y.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 17.



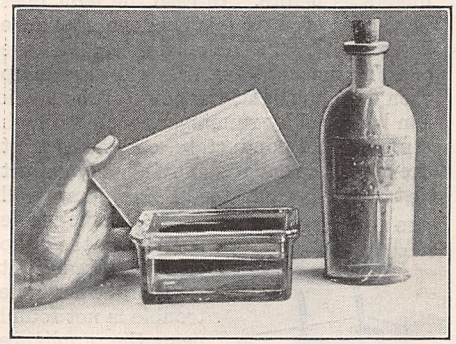
Home Workshop Chemistry

Simple Formulas that Will Save Time and Money

NUMEROUS inquiries have been received regarding ozonized or oxidized turpentine. This substance is ordinary turpentine that has been kept for a few weeks or months in an open bottle so that air is received by it and it changes from its water-white color, which is a characteristic of spirits of turpentine, to a golden-yellow color.

Ozonized turpentine can be obtained in certain stores specializing in these substances, but it is expensive. It can be prepared readily at home by pouring spirits of turpentine into a wide bowl, which must be covered sufficiently to prevent dust from entering, yet be open to the air.

The extreme rapidity with which the turpentine oxidizes depends upon the original source of the product. At times the yellow, slightly thickened and sticky



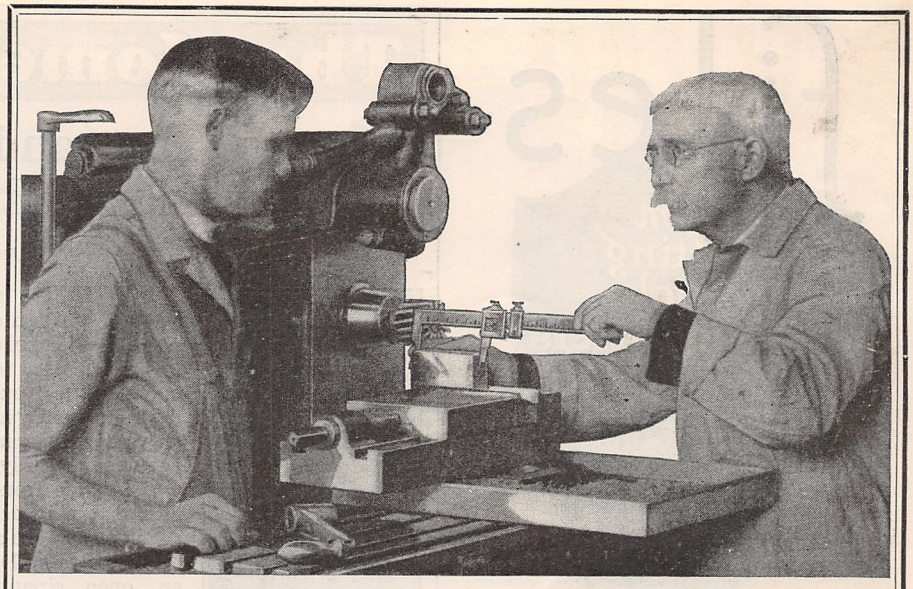
Ozonized turpentine is made simply by the exposing of ordinary turpentine to the air

product is obtained within a few weeks; sometimes it requires a few months.

This preparation of turpentine is a very useful substance and should be on hand in all workshops. It is one of the best substances to add to spirit varnishes, as has been explained in previous issues, for it helps to produce a more resistant and durable covering. Turpentine itself is not soluble in alcohol, but this oxidized product is soluble.

Linseed oil is to be obtained commercially in two important types. The first is the raw linseed oil. This usually is mixed with thicker paints that are to be thinned, for it oxidizes or dries very slowly. The second—boiled linseed oil—acts as a drier and hardens rapidly. This is due to the boiling of manganese borate or lead borate with the oil.

Two kinds of wood fillers can be obtained—paste and liquid. Both have their uses. The paste filler is used for open-grained woods, such as walnut, mahogany, oak and chestnut. Turpentine is added to thin the commercial filler to the desired consistency. Liquid fillers are employed for fairly close-grained woods or when it is desired to avoid the cost and labor of applying a paste filler.



"I've *used all* makes of tools but there's only *one* kind I *own*—"

In every machine shop can be found a man who is the acknowledged master mechanic of the shop. A life lived in handling all kinds of machines and tools has brought to him exceptional skill and a remarkable knowledge of the tools he uses. Thoroughly acquainted with mechanical equipment, he invariably insists that his tools bear the name "Brown & Sharpe."

It pays to take the advice of men who know. Build up your kit with Brown & Sharpe Tools.

Ⓢ *Send for Small Tool Catalog No. 29*

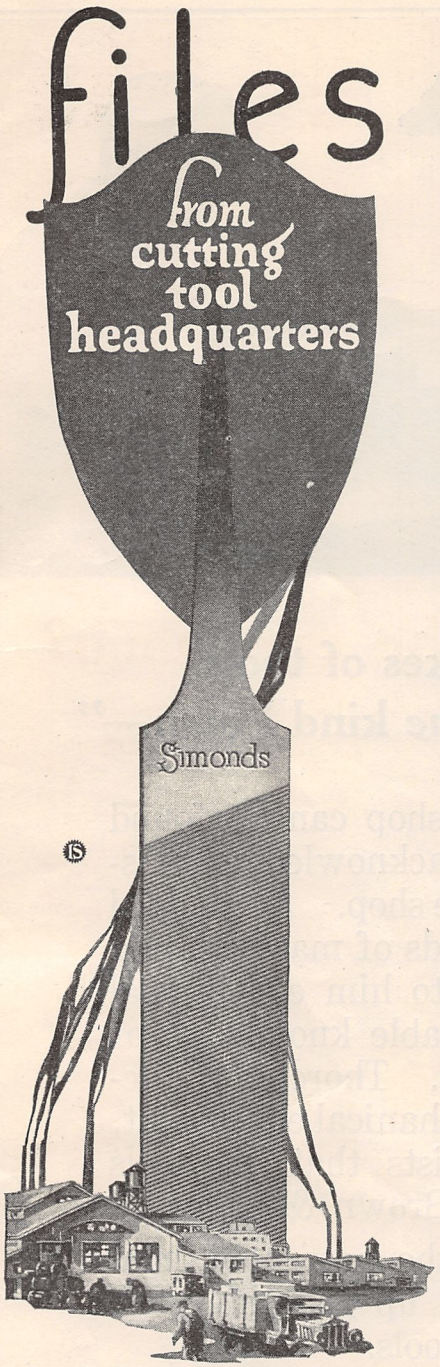
Brown & Sharpe Mfg. Co.

Providence, R. I., U. S. A.

Brown & Sharpe Tools have helped the skill of mechanics for over three generations

BROWN & SHARPE TOOLS

"Standard of the Mechanical World"



The name Simonds means just as much on a file as it does on a saw or any other cutting tool. It is a guarantee of quality—quality born of nearly a century's experience in making the finest of cutting edges from tempered steel—heat-treated by a special process to insure long life and great strength. Ask your dealer.

SIMONDS SAW & STEEL COMPANY
Fitchburg, Mass.
"The Saw Makers" *Established 1832*
Branch Stores and Service Shops in Principal Cities

SIMONDS
Pronounced SI-MONDS
SAWS FILES KNIVES STEEL

The Home Workshop

How to Test and Repair the Cords of Household Electric Appliances

By Leon C. Rice

Testing cord of an electric iron

WHEN a portable electric appliance fails to operate, the trouble is frequently in the cord and can be remedied easily.

The three troubles that may occur in a cord are a "cut-out" (Fig. 1), an open circuit, and a short circuit. Usually any of them may be found only in certain positions of the cord and sometimes a cord may show all three in different positions.

Simple tests will show the kind of trouble and where it is. To make the tests, a fuse plug block (technically known as a two-plug cut-out), costing about 35 cents, an extension cord or two lengths of wire, and a small screwdriver are needed.

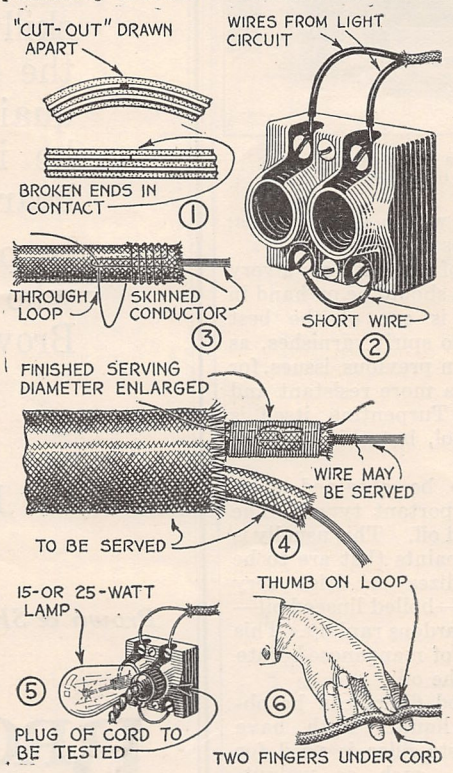
Fasten the fuse block at any convenient place where you can stand on a dry wooden floor without possibility of touching a pipe or other grounded conductor. Remove the socket from an extension cord. Attach the ends of the cord to the fuse block as in Fig. 2. Any insulated wire of 14 gage may be connected with the light wiring at any convenient point and used instead of the extension cord. Finally connect the two lower contacts of plug block with a short wire.

Screw a lamp, preferably 15- or 25-watt, in one socket and the plug of appliance cord to be tested in the other (Fig. 5). The lamp obviously will be in series with the cord and appliance when the current is turned on.

Should the lamp light when everything is connected, remove the plug from the appliance—iron, fan, heater, or whatever it happens to be. If this does not put out the light, there is a short in the cord or plugs. First examine the wiring at both plugs. If no short is found, hold the cord so as to prevent shaking, which would give false tests, and spread the index and middle fingers to let the cord rest on them. Press the cord with the thumb, bending it down between the fingers, and move slowly along the cord (Fig. 6). When location of the short is reached, the lamp almost invariably will flicker.

Should the trouble be at the attachment plug end, it is probably within 2 in. of the end. If this test does not reveal the short, it may be found by cutting small pieces off the cord until the light goes out.

If the lamp does not light when connected with the appliance, there must be an open. Take off the appliance plug and twist the conductors together. Should the lamp then light, test the cord for a cut-out by bending between the fingers as before. In case the light does not flicker, the trouble is in the appliance or contacts. To make sure, connect the ends of the cord together. If the lamp then does not light, the point of the break can be found by running a needle through the cord and conductors, commencing at the appliance end and moving only a short distance at each test. The lamp will light when the needle is between the lamp and the break. It is well, when the trouble is not found near the appliance end, to try about 2 in. from the other end before puncturing too far, as the puncturing seriously injures the cord and all cord so injured must be cut off.



A cut-out, connections for testing block, method of serving wires and the flexing test

Many expensive shorts and frequent opens and cut-outs are caused by poor workmanship in repairing cords. To remove the outer covering, cut straight around the cord about 3 in. from the end, being careful to avoid injuring the insulation on individual conductors. Rub the cover with the back of a knife blade and slip it off. The cover on some cords will not so loosen and must be split carefully. Take off all rubber or other material that binds the conductors together. This does not, of course, apply to cords having conductors not bound to-

(Continued on page 93)

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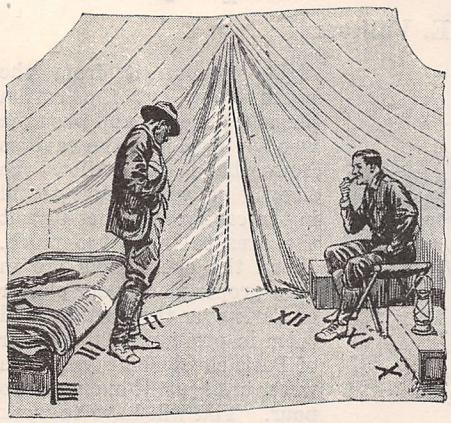
The Home Workshop

Tent Sun-Dial Aids Campers in Telling the Time



IF THE opening of your tent faces due south and is exposed to the sun, you will see that a bar of sunshine travels around the interior during the day. By marking the spots this bar of light strikes at different hours, you can improvise a sun-dial that will tell you the time on other bright days.—JAMES E. NOBLE.

Repairing Electric Cords

(*Continued from page 92*)

gether, but such cords must have outer insulation removed to reduce their size so they will enter the plug opening or openings.

Place the separated conductors in the plug to determine where the insulation should be cut. Plan for the insulation to reach binding screw without stretching.

The inner insulation when properly made is apt to ravel and must be "served." Linen thread, well beeswaxed, is best for serving, but cotton thread will do. Cut 12 in. of thread and make a loop on the cord with one end (Fig. 3). Hold the loop by placing two fingers under the cord and the thumb on the loop. Begin at the end of insulation and wind tightly and closely round and round over the loop, back to the outer cover. Put the winding end through the loop and pull the loop end until the winding thread is well under the windings (Fig. 4). Cut both ends close to the windings. Repeat on the other conductor. Serve the outer insulation, if any, in the same manner, but cut the thread 24 in. long. Begin $\frac{3}{8}$ in. from the end of insulation and serve toward the end.

Some conductors are so large that no additional bulk can be put under the terminal connections. Such should be twisted tightly. Smaller conductors should be wrapped with fine copper wire, a single wire from a drop-cord conductor being excellent.

Place conductors under binding screws clockwise. Bend the conductor around screw in a U shape. When put more than once around, the entire pressure of the screw is on the point where the conductor crosses itself, which lessens the contact area and is apt to cut off the conductor. Be sure each conductor is held securely. Cut the projecting ends close to the screws. Blow out all loose tinsel and assemble the plug.

Who owns the telephone?

For seven carefree years young John Graves worked in the car shops at Orenville, spending his dollars as fast as he earned them. Soon after his promotion to foreman, he was married and moved to a little white house on Orchard Avenue. Life was happier than ever, but spare dollars were not more plentiful, especially after a third member was added to the family.

Then came a day when the plant superintendent showed John the wisdom of saving a part of his earnings, for the satisfaction it would bring, and for protection against emergencies and old age. He and his young wife, for the first time, learned the difficult art of economy, and finally they came to know the joys of saving and of safe investment.

Today John Graves, and many thousands like him, own the stock of the American Telephone and Telegraph Company. This company is owned by more people than any other, and the great majority of its owners—laborers, clerks, housewives, business men and others—have bought it with their savings. As its business has grown, the number of its shareholders has increased until now one out of every 45 telephone subscribers is also a stockholder.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES
BELL SYSTEM
One Policy, One System, Universal Service

BIASCOPE $5
Pocket Binocular

Reveals objects unseen by naked eye. A necessity to campers, hunters, all sportsmen. Bisacope A, illustrated, $5: Biascope, B, pupillary adjustment, $7.

At your dealer or direct postpaid.
Money back guarantee

Wollensak Optical Company
81-83 Clinton St. Rochester. N.Y.

Easy to Draw Cartoons

When Shown in the RIGHT WAY

Some of the cleverest cartoonists and comic artists learned how to draw in their spare time by following **Cartoonist Evans' Simple and Easy to Learn Method** and are now MAKING GOOD MONEY. Send one of your drawings, and let Mr. Evans see if you have ability and receive the **Portfolio of Cartoons** and full details about the course. **It is not expensive.**

THE W. L. EVANS SCHOOL OF CARTOONING
825 Leader Building **Cleveland, Ohio**

You can't tell when you'll need it

Sooner or later your spare tube will be punctured—and then what'll you do? Ford or Packard—it happens to any car. Nor is it less likely with balloon tires.

Nearly three million motorists carry Shaler Vulcanizers for such an emergency, because they have found vulcanizing to be the quickest and easiest way to fix punctures.

SHALER

5 MINUTE VULCANIZER

Clamp a Shaler Patch-&-Heat Unit over the puncture, light the fuel, and give it five minutes to cool. That's all.

Anybody can do it anywhere and make permanent heat-vulcanized repairs—the kind you would get at a repair shop.

No cement—no gasoline—you don't even need to cut the patch to fit.

Get this "Hole Outfit" Today for only $1.50

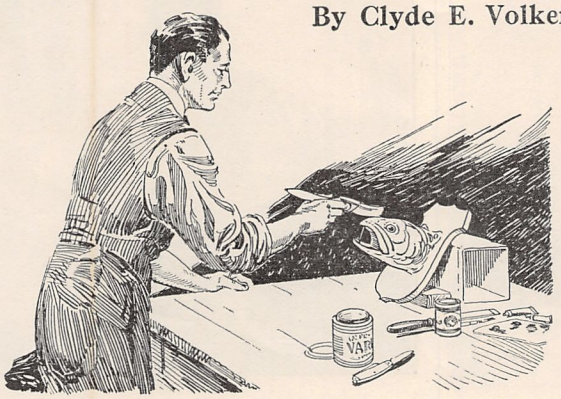
Wherever auto accessories are sold. Slightly higher in Canada and far west.

C. A. SHALER CO.
2103 Fourth Street, Waupun, Wis.

The Home Workshop

How to Mount a Fish Trophy Head

By Clyde E. Volkers



WHAT ardent fisherman has not hooked at some time a fish worthy of being saved as a trophy in his den? A fish head is one of the easiest of all trophy heads to mount. Indeed, the most difficult part is catching the fish.

To remove the head, lay the fish upon its side. Lift up the stiff flaps that cover the gills, trace with your fingers around the edge toward the top of the head, and at the beginning of the thick, fleshy part, cut through the back, severing the backbone. Cut the remainder of the head from the body close to the gill covering that encircles the body of the prized fish.

Prop the mouth wide open with a twig to make the fleshy parts more accessible from the back of the head. Make a note of the eye coloring, the size of the pupil, shape, and any other noteworthy coloring of the head.

Now reverse the head and, working from the rear, dig out all soft flesh and muscle from the inside. Be careful not to puncture the outside of the head. Remove the eyes carefully, and use care not to injure the membrane that bounds the rim of the eye cavity.

After the flesh has been removed, dust the inside of the head with a mixture of equal parts of alum and arsenic. Place plenty of the powder around the eye and brain cavities, also where the flesh was removed from the jaws. Plug the eye cavities with cotton, and tack the head upon a board to dry. Use tacks with wide heads but very small points. The gill coverings should be held in position at right angles to the mouth and eyes, or the fore part of the head. The mouth should retain the prop if the head is of a game fish.

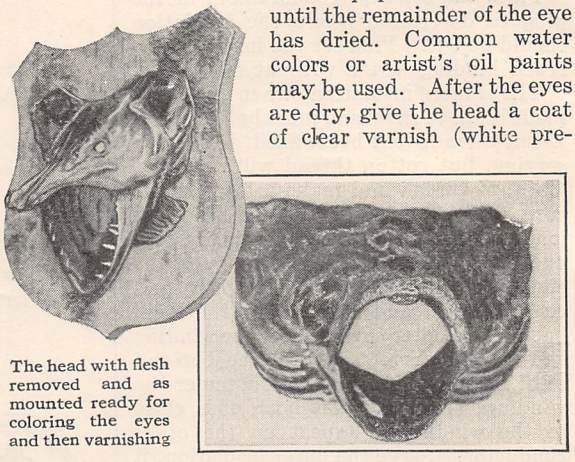
Artificial glass eyes may be purchased, but eyes made from wood will serve as well. They can be painted later in lifelike colors by reference to your notes.

If the fish is of medium size, saw off two pieces of a broom handle ½ or ¾ in. in length. One end should be curved or rounded off with a knife or file. After the head has dried for about a day and a night, remove it from the board, take out the cotton plugs in the eyes, and push the wooden eyes into the cavities from the back. Allow the slightly convex surface to fill in the cavity. Do not permit the eyes to bulge too much. When the eye blanks are in their proper place, pour plaster of Paris over the back to hold them in position. The plaster of Paris should be mixed with water until just thin enough to pour. You will have to work quickly because it sets very rapidly.

Pour more of the plaster into the cavities you made by removing the flesh. This keeps the head from shriveling. Clay may be used in place of the plaster, but it will take much longer to harden.

Cut a rough piece of ½-in. thick wood, round, square, or shield-shape, as you desire. Dress it smoothly, stain it, or cover it with dry bark removed from a dead tree. If you use bark, soak in water and then glue and tack it to the board, trimming it even at the edges. Use small brass screws in the gill coverings when fastening the head to the board.

In painting the eyes, the black or darker pupil should be left until the remainder of the eye has dried. Common water colors or artist's oil paints may be used. After the eyes are dry, give the head a coat of clear varnish (white preferred). The head should be free from lint and dirt before varnishing. After a day or two, give it another coat of varnish. In a week you may remove the prop from the mouth of the fish.



The head with flesh removed and as mounted ready for coloring the eyes and then varnishing

This trophy will keep indefinitely, and, hanging on the walls of your den, will call to mind frequently a pleasant day and happy memories along a stream with a game fish.

Helped by the Home Workshop

I HAVE been taking POPULAR SCIENCE MONTHLY for two years and can truthfully say that it is the best magazine that can be bought. The Home Workshop Department has helped me a great deal, as my hobby is woodworking.—R. W. D., Fond du Lac, Wis.

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The Home Workshop

Amazing Feats of Handicraft

(*Continued from page 77*)

with ebony; handle of scimitar, ebony inlaid with shell. The sphinx head in crescent, of Osage orange, teak, and Australian gum, inlaid with ebony and shell.

The entire top is 1½ in. thick, overlaying a moisture-proof case 3½ in. thick, secured by cement and concealed brads and screws. The size is 27 by 54 in., making each end a perfect square. Contains 4956 pieces. All hand work, finished with 10 coats of varnish and hand rubbed.

Homemade Reflecting Telescope

By LATIMER J. WILSON

Nashville, Tenn.

Third Prize

BECOMING interested in astronomy, I met with a handicap in having no telescope with which to view the heavens, so I made one. The concave mirror at the lower end of the tube (see page 77) was ground out of a ship's porthole light 12 in. in diameter. Polished and figured to the exact curve, it became the speculum for my telescope, bringing the rays of light from a star to a fine point at the focus. A piece of flat plate glass placed at an angle of 45 deg. near the upper end of the tube reflects the rays into the eyepiece at the side of the tube near the upper end. During the close approach of Mars I had some excellent views of the planet.

The glass disk is ground with carborundum spread over a similar disk mounted upon a post. Walking around the post and rotating the upper disk distributes the motion evenly when the disk is shoved forward and pulled backward in strokes of suitable length. When ground to proper curve, the speculum is polished the same way on pitch ruled off in 1-in. squares on the lower disk, which has been shaped into a convex tool during the grinding process. Bringing the curve to a parabolic instead of a spherical shape is done by polishing with slightly longer strokes and testing the surface by the reflected rays from an artificial star—a needle hole in a metal lamp chimney. In all, about 148 hours were required to complete the task. Except for the extreme edge it makes a perfect speculum, reflecting about 98 per cent of light when silvered. A cardboard diaphragm makes the telescope effective with an aperture of 11 in., and magnifications as high as 400 diameters are employed.

Traction Engine Model

By FRANK A. DOLL

Marshall, Ill.

Third Prize

THIS actual working model was built from a picture of a well known commercial steam traction engine. I had no drawings or specifications to go by.

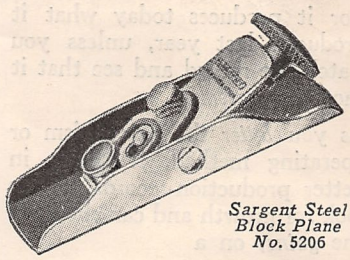
Making the driving wheels 5½ in. in diameter, all the dimensions were calculated from that and made in proportion to the picture.

The engine is 18 in. long and 9¼ in.

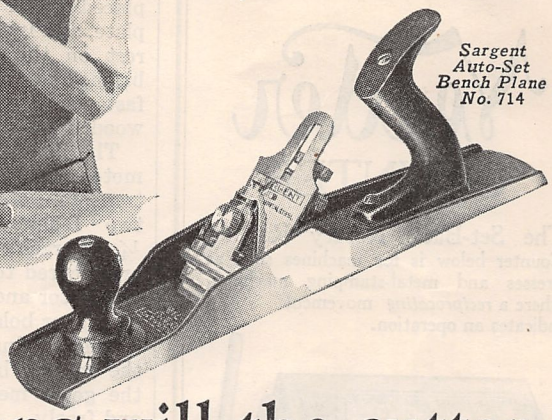
(*Continued on page 97*)

SARGENT

PLANES



Sargent Steel Block Plane No. 5206



Sargent Auto-Set Bench Plane No. 714

How long will the cutter *hold its edge?*

THAT'S the first question you should ask when buying a plane. It's a question that the Sargent cutter of chromium steel answers most satisfactorily. It retains its sharpness *longer* than cutters made from other alloys.

Chromium steel was selected for the cutters in *all* Sargent Planes only after extensive tests proved its unusual toughness and edge-holding quality. Chromium steel also permits the use of a thin blade—and the thinner the blade the keener its cutting edge. It is even sharpened more quickly when whetting does become necessary.

There are other features embodied in the two Sargent Planes illustrated above. In the Auto-Set, the cutter may be removed, sharpened and replaced without changing original adjustment. This is a great time-saver. In the Steel Block Plane the low angle of cutter particularly suits it for end work. It is a great tool for the smaller jobs. These two planes should be on every home and school work-bench. See them at almost any good hardware store and write for booklet.

SARGENT & COMPANY, *Manufacturers*

50 Water Street New Haven, Conn.

Design, Workmanship, and finish of the highest order are found in all

Gerstner Tool Cases

for

Toolmakers and Machinists

They please. Write for free catalog.

H. GERSTNER & SONS

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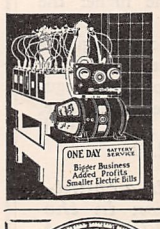


ONE DAY BATTERY CHARGING PAYS BIG

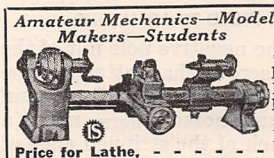
Start now making big money recharging auto and radio batteries with new system. **$35 cash brings complete HB One Day Battery Charging Outfit**, Long, easy payments. No experience needed. Big profits easily made. **30 days' trial on money back guarantee. Write for free bulletin.**

HOBART BROS. CO.,

Box P 7 - - Troy, Ohio

YOU CAN CLEAR $150 to $300 MONTHLY PROFITS

Amateur Mechanics—Model Makers—Students



Wade Bench-Lathe

Cap: 4" dia. x 12" length. Sliderest has travel entire length of bed. Lead-screw inside bed. Hollow spindle.

Price for Lathe, - - - - - - - - - - - - $28.00

Complete line of accessories at equally low prices. Literature free.

THE GEROLD COMPANY

Dept. P. S. 3, 120 Liberty Street, New York

(Patented 1-17-22)

The Midget "Five-in-One" Slide Rule

is a combination Mannheim, Polymetric, Log-Log, Binary, Add and Subtract Slide Rule. It will instantly add, subtract, multiply and divide any combination of whole numbers, fractions, mixed numbers and decimals. Gives every root and power, also Logs, Sines and Tangents. Made of aluminum with scales on white celluloid. Size 4 in. Approved and adopted by colleges. Price with Instructions, $1.50. Leather Case 50c extra. Sent C.O.D. if desired. Catalogue Free. **GILSON SLIDE RULE CO., Niles, Mich.**

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 17.

Machines Grow or Stand Still

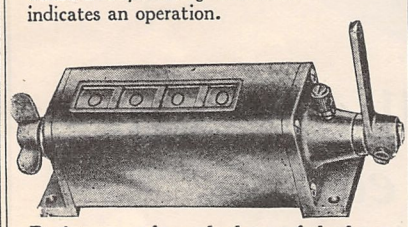
Your machine may seem to be running fine—yet may be standing still!

For it produces today what it produced last year, unless you watch the record and see that it shows *improvement*.

As you *better* the mechanism or operating method, it shows in better production-records. You look for growth and can check up the *gains*, on a

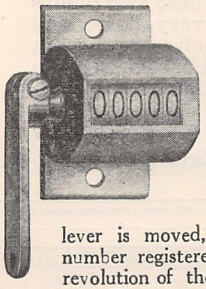
Veeder COUNTER

The Set-Back Rotary Ratchet Counter below is for machines such as presses and metal-stamping machines, where a *reciprocating* movement indicates an operation.



Registers one for each throw of the lever and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figures, as illustrated, $11.50—subject to discount. (*Cut less than ½ size.*) Set-Back *Revolution* Counter of similar model, $10.00 (*list*).

This small Rotary Ratchet Counter (No. 6) counts reciprocating movements of the lever, as required for recording the output of innumerable small machines When the lever is moved through an angle of 40 to 60 degrees, the counter registers one. The further the lever is moved, the higher the number registered. A complete revolution of the lever registers ten. This counter can be adapted to no end of counting purposes, by regulating the throw of the lever. Price, $2.00. (*Cut nearly full size.*) Small *Revolution* Counter, also $2.00.



Whatever you need in a counting device is shown in the 80-page Veeder booklet. Sent free to aid your development-work.

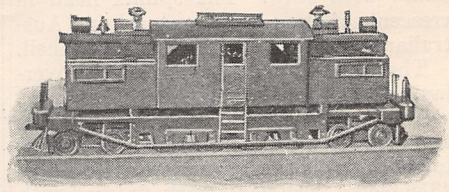
The Veeder Mfg. Co.
44 Sargeant St., Hartford, Conn.

The Home Workshop

How to Wire Model Locomotives

Fifth article in a series on small electric railways

By Edward E. de Lancey

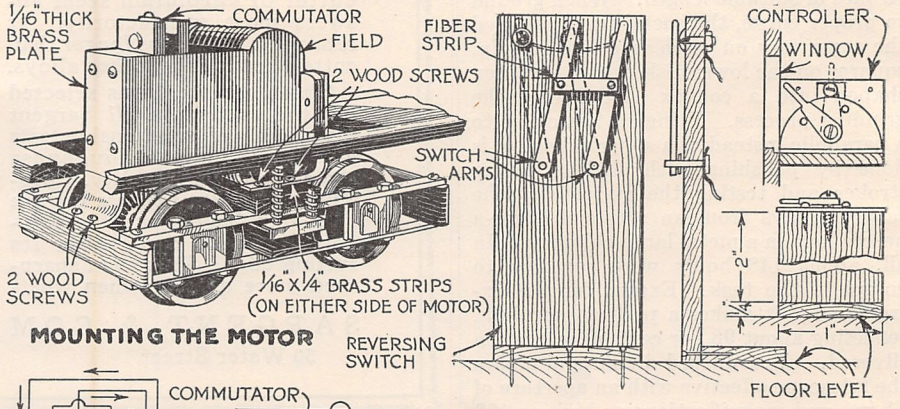


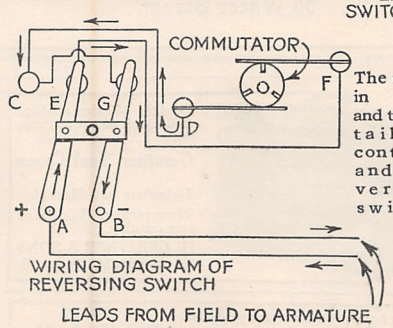
OUR model now resembles a short flat car. The electric wiring and cab proper remain to be dealt with. It will be more convenient to do our wiring first, while the cab is out of the way. The method of fastening the motor to its truck is illustrated. At the armature end of the motor, a thin strip of sheet brass is placed under (or instead of) the name plate, and is so bent at its lower end as to rest on the front buffer beam, to which it is fastened by two small wood screws.

The field end of the motor rests upon the upper transom, steadied with two L-shaped 1/16 by ¼ in. brass straps, which are secured to the lugs of the motor and screwed to the upper bolster.

Before finally setting the motor, be sure that the gears mesh correctly and freely. It is not necessary that the armature spindle be perpendicular, but it must be truly *radial* to the larger gear.

For the wiring use insulated wire throughout, but always polish the exposed ends of the wire with fine sandpaper, before making a connection. Cut off a piece of insulated wire of sufficient length





The motor in place and the details of controller and reversing switch

to reach from the negative pole nut of the motor to the screw that attaches the return current shoe to the buffer beam. Using your round-nosed pliers, make a small loop in each of the stripped ends of the wire. Slip one of these loops under the pole nut and screw it tightly. Slip the remaining loop under the head of the shoe screw and tighten that also. In selecting the route of this wire, all that is necessary is to locate it so that it is in no danger of fouling any moving part.

The controller is a simple circuit breaker, so mounted as to resemble the usual controller box and handle. It is merely half of a solid wooden cylinder—an old broom handle—split lengthwise along its diameter, and fastened with brads to a ¼-in. wooden base, which in turn is screwed to the floor of the cab. It should be so located that the handle can be manipulated conveniently through a cab window. To give it a finish, a scrap of sheet brass should be cut to shape and fitted on the top so as to project about 1/16 in. over the edge.

A contact point may be made at any part of the top of the controller box. This need be only a strip of wood attached to the side of the box with a small round-headed brass screw in the top. The controller handle is a scrap of 1/16 by ¼ in. brass, drilled at one end for a screw and filed at the other end to the shape shown. Thin brass brads should be driven into the top of the controller box, to act as stops for the handle.

A wire is run from the positive binding post of the motor to the contact screw of the controller and another wire from the controller arm to one of the screws of the third-rail pick-up shoe. A motor such as we are describing can be reversed by transposing the terminal wires of the main field magnet from one commutator post to the other. It would be too long a

(*Continued on page 97*)

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The Home Workshop

How to Wire Model Locomotives

(*Continued from page 96*)

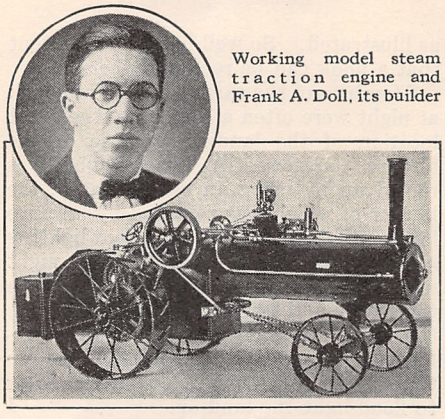
process to attempt this every time we want to back up, and, therefore, a reversing switch must be employed. Such a switch is illustrated.

The terminal wires of the motor's field winding are detached from the commutator posts, lengthened as much as necessary, and connected with the two switch arms at *A* and *B*. Then introduce a new piece of insulated wire from point *C* of the switch to *D* of the commutator, and another from *E* of the switch to *F* of the commutator. Points *C* and *G* must be connected with a wire. The beginner will find it advisable to buy his reversing or pole-changing switch instead of attempting to make it.

The cab construction will be described next month.

Amazing Feats of Handicraft

(*Continued from page 95*)



Working model steam traction engine and Frank A. Doll, its builder

high over all. It uses alcohol for fuel, and water is fed to the boiler from a supply tank on the platform by a pump that runs off the crankshaft.

The steam is superheated and the engine is double acting with reversible slide valve gear. The engine was made entirely by hand, even to the pipe fittings—everything except the gears, and they were taken from old clocks. There is only one casting and that is the flywheel, which is of Babbitt metal. All the other parts were cut from solid scraps of brass, copper, sheet iron, and wire.

Honorable Mention

For especially meritorious work, honorable mention is given the following:

Herbert B. Collier, of Viking, Alberta, Canada, for a relief model of the moon.

E. M. Cook, of Des Moines, Ia., for a carved chest.

William W. Flanigan, of Cedar City, Utah, for an inlaid table.

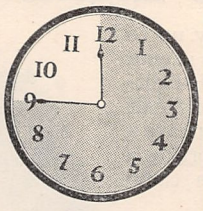
Douglas H. Burt, of Indianapolis, Ind., for a miniature ship model.

Charles H. Fernald, of Malden, Mass., for a phonograph.

Martin A. Ellingson, of McCook, Neb., for an electrified dining cabinet.

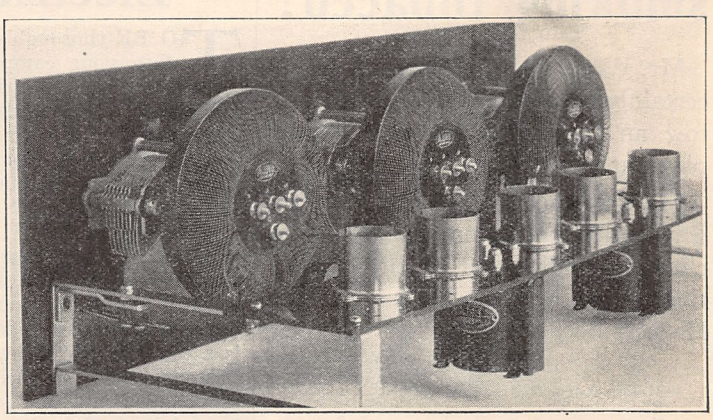
Photographs of the work of those given honorable mention and a number of other projects selected from this contest will be published next month and in following issues of POPULAR SCIENCE MONTHLY.

Build this phenomenal new radio *in 45 minutes*



The revolutionary Erla Circloid-Five Factory-Biltkit as you receive it.

Price $49.50.



This new type kit is factory assembled. Ready cut, flexible, solderless leads make it ridiculously easy to wire. Amazing new inductance principle brings results hardly thought possible. Send for book "Better Radio Reception."

NOW anyone can build the finest of receivers in only a few minutes. No more wire bending or soldering. Merely attach a few ready cut, flexible eyeletted leads and the job is done. The finished set challenges comparison with the costliest factory built receivers.

But most amazing is the new inductance principle incorporated in this last word in kits—called the Erla Circloid principle of amplification.

Four vital improvements results from this great discovery, which are not found in ordinary sets.

1. ***Greater Distance:*** Erla Balloon Circloids have no external field. This enables concentration of proportionately higher amplification in each stage, with materially increased sensitivity and range.

2. ***More Volume:*** Increased radio frequency amplification made possible by Erla Balloon Circloids gives concert volume to distant signals inaudible with most receivers of conventional type.

3. ***Increased Selectivity:*** Erla Balloon Circloids have no pick-up quality of their own. Hence only signals flowing in the antenna circuit are amplified. Static is greatly reduced for this reason.

4. ***Improved Tone Quality:*** The self-enclosed field of Erla Balloon Circloids eliminates stray feed-backs between coils and consequently does away with mushing of signals and distortion due to this cause. Tone is crystal clear.

Write for free information on kit—also book

See how 45 minutes of fun will give you the newest and most nearly perfected set known to radio science. Easy as A-B-C to finish. Examine it at any Erla dealer's, or send the coupon for full information, illustrations and diagrams *free*. Also ask for remarkable new book "Better Radio Reception," describing the sensational new Circloid principle. Enclose 10c for mailing and postage on book.

*Trade Mark Registered

Electrical Research Laboratories
2515 Cottage Grove Ave.
Chicago, U. S. A.

ERLA

Send me free information on kit. I enclose 10c for postage for book "Better Radio Reception."

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Dealers—Exclusive franchises are available to high class dealers in localities still open. Write or wire immediately.

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Just send us your name and address and say which of these helpful books you want and we will send it FREE. Write NOW.

E. C. ATKINS & CO., Inc.
Dept. D-20 Indianapolis, Ind.

AIR COMPRESSORS

FREE AIR for your customers will boost your business. That's why garages and service stations the country over are using the dependable Franklin Super-Single Stage Air Compressor. Write today for free illustrated booklet on *Franklin Aids to Better Business*. Franklin Air Compressor Works, 2620 Main St., Norristown, Pa.

CORONA FOUR

With standard office keyboard—an office typewriter in portable form.

Write for literature.

Corona Typewriter Co., Inc.
112 Main St., Groton, N.Y.

Wire-Nuts for joining

radio antenna and lead-in wires in one minute without solder, tape or tools.
Many other uses. A million perfect joints have already been made with these new Wire-Nuts.
Listed by Underwriters' Laboratories. Booklet free.
Ask your dealer for Wire-Nuts.
We will send 3 Wire-Nuts post paid on receipt of 25c.
W. TORK COMPANY, 8 W. 40 St., New York

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Is there really a climate-proof smoking tobacco?

Mr. W. L. Peers is an aviator who certainly has "flown wide," to borrow an expression from his own pleasant letter.

He writes us that he has smoked Edgeworth under practically every climatic condition in seventeen sections of the world, outside America. He says:

Bolling Field, D. C.

Messrs. Larus & Bro. Co.,
Richmond, Va.
Gentlemen:

Having been a constant user of your excellent Edgeworth for approximately twelve years, and having smoked it under practically every climatic condition in the following countries: England, France, British West Africa, South Africa, German East Africa, Mesopotamia. Persia, Palestine, Egypt, India, Afghanistan, Beluchistan, Waziristan, Ceylon, Burmah, The Straits Settlements, and China, I feel it an honor to go on record as a supremely satisfied user of this tobacco.

Of course it was not always possible to obtain the "Old Blue Can" in all of these countries, but where this difficulty was encountered, my fondness for Edgeworth could not be satisfied by an inferior product, so I arranged with my people in Richmond, Virginia, to purchase a dozen or so cans at a time and forward it to me by parcel post.

I was considerably gratified on my arrival at this field to find that the majority of the men here, both commissioned and enlisted, who smoke pipes, are veteran users of Edgeworth. I consider that this shows excellent taste on the part of the men at this station.

May your organization and your Edgeworth always "Fly High, Wide and Pretty."

Yours for pipe satisfaction,
W. L. Peers

Let us send you free samples of Edgeworth so that you may put it to the pipe test. If you like the samples, you'll like Edgeworth wherever and whenever you buy it, for it never changes in quality. Write your name and address to Larus & Brother Company, 10 G South 21st Street, Richmond, Va.

Edgeworth is sold in various sizes to suit the needs and means of all purchasers. Both Edgeworth Plug Slice and Edgeworth Ready-Rubbed are packed in small, pocket-size packages, in handsome humidors holding a pound, and also in several handy in-between sizes.

We'll be grateful for the name and address of your tobacco dealer, too, if you care to add them.

To Retail Tobacco Merchants: If your jobber cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dozen carton of any size of Edgeworth Plug Slice or Edgeworth Ready-Rubber for the same price you would pay the jobber.

The Home Workshop

Electric Lights for Your Camp

TO BE thoroughly up to date your camp should have an electric-lighting system. It is not difficult to arrange for this if you have a boat or car for transporting a storage battery to the camp site.

One electrically lighted camp, where the tent used is of the tepee type with a single central pole, has a central dome-light. The reflector is a ten-cent tin basin, the bottom of which was slit star-shaped and the points turned up to form ears for attaching it to the tent pole. In order to get the basin around the pole, the metal was split through one side as shown. When in place the ends were lapped over each other and held together with a small bolt. Holes were provided for two auto headlight lamps and their sockets.

An extra auto battery that had been used the previous winter for radio purposes furnished the necessary current. The battery, concealed under a cot bed, was wired through a switch to the lamps as illustrated. So well lighted is the tent that a book can be read anywhere in it.

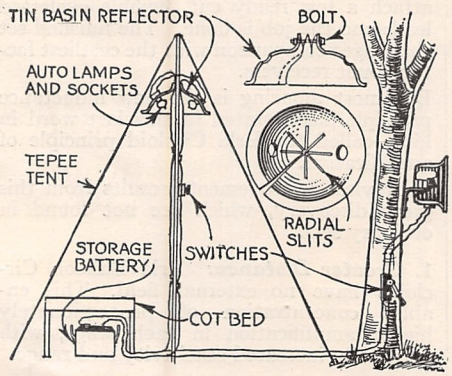


Diagram showing installation of dome-light in tent and beacon-light for a boat landing

Members of the camp coming into dock at night were often at loss as to the exact location of the landing because of the intense darkness. A beacon-light was rigged up by using an old gas lamp, the burner of which was replaced by an auto lamp. This was wired to the tent lighting system. Members coming in at night now hail those in the camp, who throw in the switch and thus guide the canoeists to the dock. In many cases it might be preferred to place the dock light higher up than shown and point it downward so as to flood-light the landing.

Dry cells and miniature lamps could be used instead of the auto equipment. Even if such an outfit did not give much light, it would surpass in convenience the old-style candle or oil lantern or even a flashlight.—C. M. WILCOX.

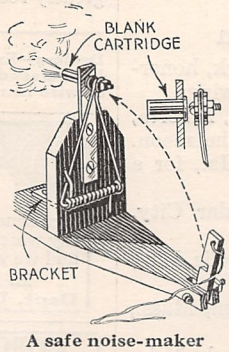
LEAD filings taken from an ordinary lead pipe by a coarse rasp and sprinkled on the threads of a pipe joint are said to give tighter joints than the paste ordinarily.

Rat-Trap "Cannon" Shoots Blank Cartridges

A NOVEL Fourth-of-July noise-maker that costs only a trifle to construct and is safe and foolproof, if used with reasonable care, is the rat-trap "cannon" illustrated. It fires .22-, .32-, or .38-caliber blank cartridges.

Besides a rat trap, two small angle brackets are needed. One is used to brace the trap upon the wooden base; two wood screws also are driven through the bottom into the trap. The other angle is straightened — or a straight mending plate may be used. The end hole in this is used to hold the cartridge. A small bracket of standard size fits a .22 blank nicely.

The rat trap is cut off below the spring and the wire arm bent in the shape of a V. A washer is placed on each side at the top angle, and a nut and bolt are used to hold them.



A safe noise-maker

The trigger is a small piece of metal or wood with a hole in both ends and a slot in one edge. It is held in a slot in the base by means of a nut and bolt. A piece of string may be tied to the top hole so that the device can be fired from a distance.—T. C. DANIEL, Wilmington, N. C.

"I WISH to compliment you on your excellent magazine, which I note has greatly improved since I last saw a copy. It fills a particular place in any mechanic's reading matter."—R.W.C., Williamsport, Pa.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 17.

The Home Workshop

Camping in Comfort

(Continued from page 79)

The camp should be made on sloping ground, if possible. The platform at its lower end should be raised about 2 ft. to insure dryness. This space also provides storage room for a canoe and other camping equipment.

The foundations may be wooden posts or cement piers. Aluminum pie plates are placed on each after they are leveled up and in each pan is laid a brick. The main side and center joists, which should be 2 by 6 or 2 by 8 in. planks, are laid on the bricks. Blocks 5 by 5 by 14 in. are bolted at the corners, or two or three pieces of 2 by 6 in. beams are nailed on to support the end floor beams, which should be 2 by 6 in.

Alternate beams extend out on each side far enough to support the guy-rope rail. The floor beams are spaced 24 in. center to center. All the joints, beam ends, and corner blocks should be coated with heavy paint for protection when the platform is being built.

If you wish a fly, you will need two guy-rope rails, the one for the fly being out beyond that for the tent.

Lay your floor on a dry day, but don't place the boards too tightly together so that they will swell and buckle in damp weather. Lay a "two-by-four" around the edge of the floor except at the door, and put up your 2 by 4 in. railing. The rails should be about 9 in. higher than the side walls.

If you wish a veranda, bolt 2 by 4 in. floor beams to the side joists of the tent platform, as shown. These beams, as well as the stairs, should rest in pans, which are kept filled with water, like those on the main posts, to form a barrier against ants and crawling insects. A space 3 in. wide is left between the tent floor and the veranda floor.

Anchor rods, made of 1-in. pipe, pass through a 2 by 6 in. by 3 ft. plank buried about 3 ft. in the ground, as illustrated. Old pipe fittings are screwed on the bottom of the anchor rods to keep them from pulling through, and the upper ends go through blocks bolted to the inside of the side joists. These anchor rods make the whole camp platform windproof.

When a large party is to be entertained, you can build sleeping boxes about 7 by 7 ft. in area, as illustrated. A shower bath also can be provided, and for cold weather it is possible to use oil heaters as shown, piping the hot air to a floor register.

Given several coats of paint, the platform can be left down all year around.

Protecting Unmounted Mirrors

THOSE who have had occasion to use unmounted mirrors, especially in laboratory work, know how easily they become scratched and rendered useless. After experimenting, I found that the best protection was to coat a sheet of typewriting paper with shellac and then press the silvered side of the mirror upon it at once. When dry, the edges are trimmed with a sharp knife.

Where is the man with the hod?

When you pass the next tall building under construction, watch the hoist run by an electric motor.

Compare the work, and the wages earned by the skilled man who runs the hoist, with the old-fashioned painful methods, and the dollar daily wage.

Each generation provides better work for men to do.

Motors made by the General Electric Company will carry men and materials over the ocean, or to the top of the tallest building. They will do your washing, your sweeping and your sewing. Almost every day, a new use is found for them.

GENERAL ELECTRIC

AGENTS 500% PROFIT
GENUINE GOLD LEAF LETTERS

Guaranteed to never tarnish. Anyone can put them on stores and office windows. Enormous demand, large profits, Paul Clark says: smallest day $28.70. R. L. Reel made $920 in two months. Write today for free sample and liberal offer to general agents.

METALLIC LETTER CO., 433A N. Clark Street, Chicago

INSIST UPON AMSCO RHEOSTATS FOR ALL TYPES OF TUBES

$75. to $150. Weekly

INSTANT WELD Welds Rubber Instantly. Better, quicker, and easier than vulcanizing. ONCE ON—ALWAYS ON. No Heat or Cement required. Repeat orders sure. Big profits. Appoint sub agents. Write today.

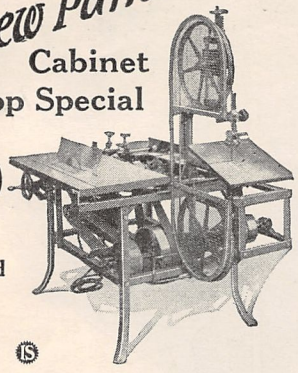
TOURISTS' PRIDE MFG. CO.
Desk No. 30G Minneapolis, Minn.

BURN YOUR NAME ON TOOLS WITH ARKOGRAF

Protect your tools from theft. Write any name, engrave any design on tools and metal with electricity like writing on paper with pen or pencil. Complete outfit $3.50, prepaid anywhere. Interesting descriptive circulars free. Write to-day. Agents wanted.

Arkograf Pen Co., 1171-A East Stark St., Portland, Oregon

A new Parks! Cabinet Shop Special No. 7 $250 As Illustrated with motor Ⓢ



THE MOST POPULAR MACHINE PARKS EVER BUILT! A winner from the start. A real machine, yet convenient size for the small shop. Does everything in woodworking. Has circular rip and cut-off saw, 6-inch jointer, 16-inch bandsaw. Lathe and shaper attached if desired at small cost. Operates from any light socket. Just plug in and go to work!

Write for interesting circular

The Parks Ball Bearing Machine Co.
1547 Knowlton St., Cincinnati, Ohio
Canadian Factory: 200 Notre Dame East, Montreal, Canada

PARKS WOODWORKING MACHINES

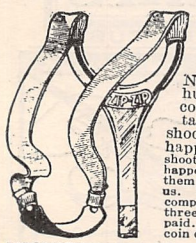
For a Real paint job nothing is equal to a good Brush!

REGARDLESS of the claims made for paint spraying devices, Brushes are still the tools of *Better Painting.*
Wherever long life, fine appearance and lasting protection are more desirable than a possible small saving in first cost, *Brushes must be used.*
And remember this—
Whiting's Celebrated Brushes
Adams Superior Brushes
have been preferred by Master Painters for more than one hundred years.

Send for Illustrated Literature

WHITING-ADAMS
BOSTON

Brush Manufacturers for over 117 years and the largest in the World



ZIP-ZIP
LET'S GO BOYS

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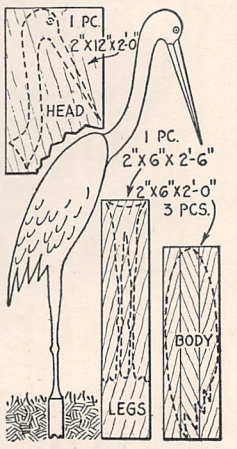
AUTOMATIC RUBBER CO., Dept. 22, Columbia, S. C.

The Home Workshop

Wooden Stork Ornaments the Garden

STANDING proudly beside a rock-rimmed garden pool, this stork adds a fine touch to an informal garden. Three strips, each 2 by 6 in. by 2 ft., surfaced both sides, are glued together side by side to form the body. The outline is marked on this and then cut with a bandsaw. If the cutting has to be done by hand, the three pieces can be sawed separately, before being glued. Finishing touches are given with chisel, rasp, and sandpaper.

On another piece of surfaced wood, 2 by 6 in. by 2 ft. 6 in., trace the legs and cut them out, leaving them joined together at the knees, if you prefer, for the sake of strength. The legs are rounded with a chisel and curved at the top to fit the curve of the body where the two are nailed together.



How the parts are drawn and cut out

For the neck and head, a piece 2 by 12 in. by 2 ft. is used. The lower end of the neck, which is shaped to fit the body, is somewhat rounded off with the chisel.

Painting removes the "flat" look, and makes the stork seem quite lifelike. A gray color is used, with dashes of black for the feather ends, and yellow for the bill and lower legs. Easier to make but less realistic is a stork cut from a single thickness of 1⅛-in. board. — A. MAY HOLADAY, San José, Calif.

Varnish Remover Made with Flour and Lye

ONE of the quickest acting and best varnish removers I use is made of flour paste and lye. Mix a thin flour paste and to this add about half as much lye as the bulk of the paste, and stir until smooth.

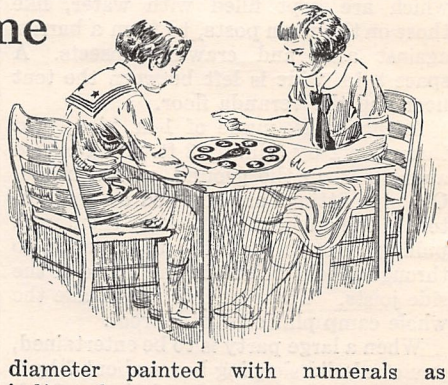
Apply the mixture thinly with a rag or brush to the painted or varnished surface that you wish to remove.

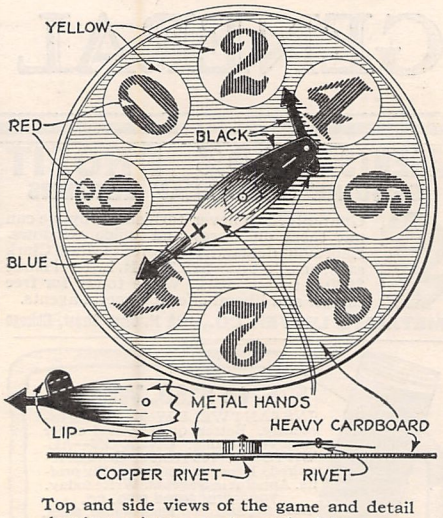
Do not allow it to set too long after the varnish or paint has softened or the wood will be darkened by the lye. Remove with a scraper and wash the wood immediately.—R. E. DEERING.

Plus and Minus Game

EDUCATIONAL as well as amusing, this easily made number game aids in teaching children addition and subtraction.

An arrow-like arm 4⅝ in. long is cut out as shown and to the blunt end is loosely riveted a smaller hand, 1 in. long. The main arm then is mounted by means of a copper rivet and a leather or rubber washer on a cardboard disk 8 in. in diameter painted with numerals as indicated.





Top and side views of the game and detail showing pointer or plus end of large arm

The players spin the large arm by snapping a finger against the lip. When the arm comes to a stop, the actual count is determined by subtracting the number toward which the small arrow points from the number indicated by the large arrow. For instance, the illustration shows a play that reads 4 minus 2, giving a score of 2. The three *nearest* numbers *only* are allowed at the minus hand.

In case the minus number is larger than the plus number, the player makes no score. When the children learn the game thoroughly, however, it adds interest to consider such a play as the loss of the number of points indicated and to subtract it from the total score, but that can be left to an understanding between the players.—D. W. C.

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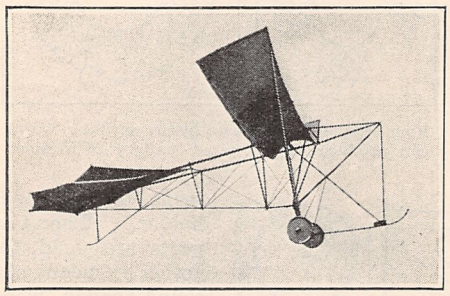
The Home Workshop

Monoplane Glider Model

(*Continued from page 82*)

through, fastening as in joint No. 1. Put in the two No. 15 sticks with joint No. 4 and fasten No. 8 to one No. 15 stick and the No. 1 stick with joint No. 4. Take the two No. 12 sticks and join with the four No. 13 sticks, using joint No. 4.

Put in the two No. 11 sticks, using joint No. 4 at sticks No. 2 and joint No. 2 at stick No. 6. Fasten the two No. 3 sticks together at *B* and join to ends of No. 2 sticks, using No. 4 joint. Fasten stick No. 4 to No. 3 sticks at *B* and to No. 6 stick at *C* with split joint as shown in joint No. 3. Put in stick No. 10, fastening it to No. 6 with joint No. 4. Fasten stick No. 5 to the No. 3 sticks at *B* and to No. 9, using butt joint as shown in joint



The flight is begun either by towing the glider or releasing it from an elevation

No. 5, also joining in stick No. 10. Now fasten No. 10 to No. 4 at *D* with No. 4 joint. Fasten axle No. 16 to No. 9, using No. 4 joint. Then put in the No. 22 sticks with No. 4 joints at both ends. Bend stick No. 23 and fasten to No. 1 with simple wrapped joint, and to No. 8 with butt or No. 5 joint.

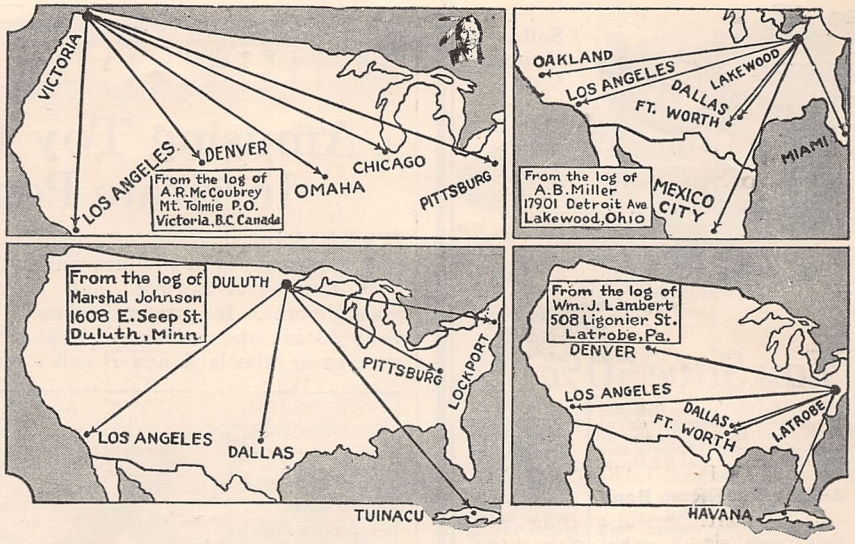
PUT in all the guy lines as shown in the drawing; these hold the plane in shape, and afford a means of truing it up when out of alinement.

The wheels are turned from wood and may be purchased at a cabinet shop. A pair of 5-in. baby-carriage or disk wheels with rubber tires may be used instead, but in that case it is best to use a piece of steel tubing for an axle.

It is advisable to cover this model with light-weight cloth. Put it on top of the sticks, allowing enough around the edges to lap under, and sew in place, being careful not to stretch the cloth tightly. A dressing to stop the air from passing through the fabric is made and applied as follows: Put two tablespoons of laundry starch into half a glass of water, mix well, and pour into a pint of hot water. Boil for five minutes; then apply freely to the cloth with brush or sponge.

When the model is finished it should be suspended at the balancing point, which is 2 in. back from the front edge of the plane, and a counterweight placed as shown in the drawing. The size of the counterweight should be increased or decreased until the model hangs perfectly level. An easy way to do this is to use a number of pieces of wire solder tied in a bundle, the balance being obtained by

(*Continued on page 103*)



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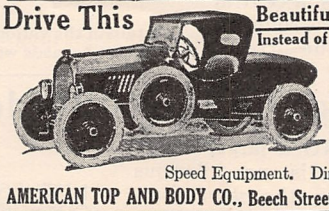

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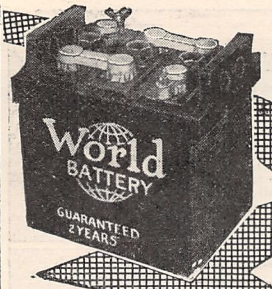

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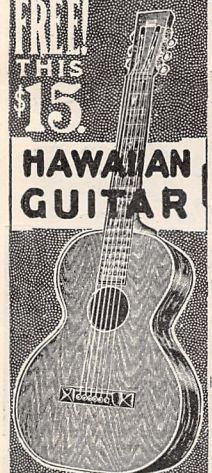

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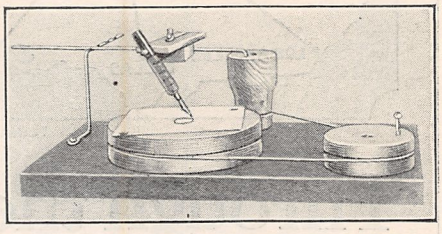
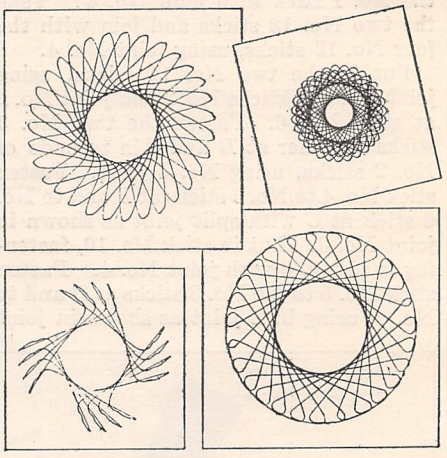
The Home Workshop

Amusing Toy Produces Variety of Intricate Pen-Drawn Designs

THIS amusing and very easily made apparatus will produce an endless number of intricate and unusual linear designs. It consists of a base ¾ by 7 by 13 in., upon which are located two sheaves or wheels *A* and *B* and a crank



The constantly moving pen draws a curious design upon the paper as it revolves and a surprising number of interesting designs may be obtained by adjusting the parts that support the pen, and by changing the end of the wire from one hole to another

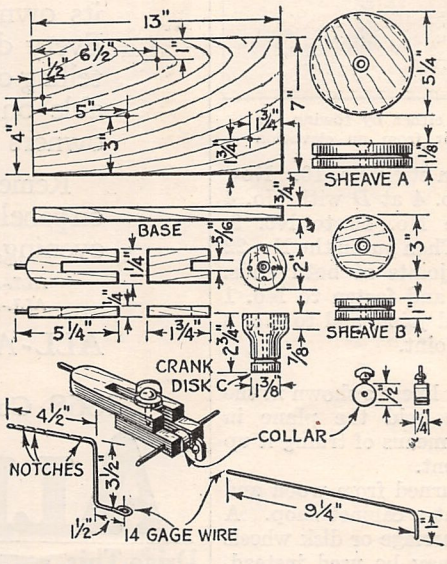


Four simple figures drawn by the machine, which can produce an unlimited variety of designs

disk *C*, each provided with a groove to carry a belt of cord.

Disk *C* carries the wire arm that supports the pen-holding device. It has five ⅛-in. holes bored to a depth of ⅞ in. in its top surface.

Two parts are used in holding the pen, one of which easily revolves on the wire arm, but is kept in place by a small collar and setscrew, as shown in detail. Upon this first block is mounted another piece of ¼-in.-thick stock, which has a central slot and one rounded end for the attachment of the penholder. The two parts are held together by means of a round-headed wood screw with a small thumb piece of brass.



Details of the various parts, which, however, need not be made with any especial accuracy

The device is assembled as shown in the photograph. The paper is placed upon the large wheel.

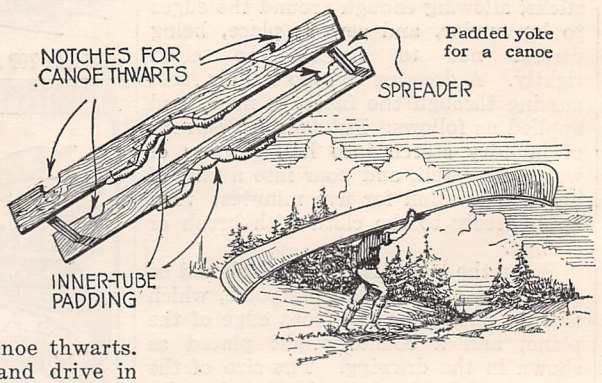
Various designs are obtained by adjusting the two parts carrying the penholder, by moving the wire arm from one to another slot in the arm support, and by changing the end of the wire from one to another of the holes in the wheel *C*.—W. E.

Yoke Lightens Burden of Carrying a Canoe

TOTING a large, heavy canoe is no hilarious dream for the man compelled to carry it any considerable distance. For one who is in the wilds only for a short vacation, such work is severe punishment. To lighten it he can use a yoke made as illustrated.

Light boards or slabs and old inner-tube sections are used. Cut two pieces of board about 1 ft. longer than the distance between the canoe thwarts. Bore holes into each end and drive in two round spreaders to separate the boards a convenient width to fit over the shoulders. They should be the same distance apart at each end.

Cut notches for the thwarts in each end, slanting them slightly. Hollow out



places for the shoulders and pad them with sections of old automobile inner tube. By drilling several small holes in the boards, the tube can be laced on securely with heavy cord or leather thongs.—L. B. ROBBINS.

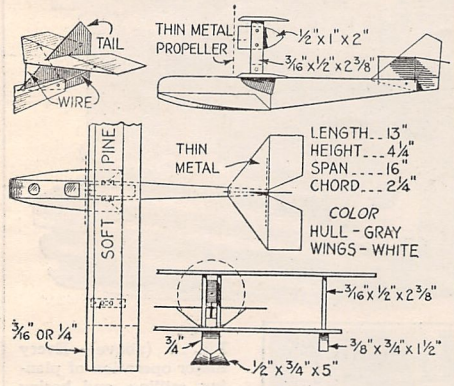
The Home Workshop

How to Whittle a Realistic Toy Flying-Boat Cruiser

By Donald W. Clark

LIKE the toy passenger air coach illustrated last month, this remarkably realistic flying-boat cruiser can be made with a penknife and a few of the more common household tools.

The hull is whittled from a piece of soft wood ¾ by 1½ by 11½ in., with two



Hull, wings, and engine are whittled from wood; tail members and propeller are of thin metal

pieces of ½-in. stock added as indicated to provide the additional thickness that is needed for the pontoons. One wing is 3/16 or ¼ by 2¼ by 16 in.; the other is 12 in. long. The dimensions not indicated in figures can be estimated closely enough by eye.

The third toy in this series will be a racing airplane.

Mixing Ivory-Tinted Enamel

WHITE enamel can be tinted an ivory color by mixing with it a small quantity of medium chrome yellow or French ochre oil colors, which are sold in small tubes as artist's colors.

Monoplane Glider Model

(*Continued from page 101*)

adding or removing a piece. In case baby-carriage wheels and steel axle are used, the counterweight may be much lighter or dispensed with entirely, depending upon the weight of the wheels.

A towline is fastened on stick No. 5, about halfway down from No. 3 sticks. Set the plane on a smooth piece of ground and run with it against the wind. If it rises too abruptly and has a tendency to roll over on one side, slide the towline up a little higher on No. 5; if it does not rise easily, lower the towline. When the desired location is found, tie and glue the line firmly in place.

When the model is released, carrying the string with it, it should glide gently to earth, landing easily on the wheels. If it has a tendency to make a nose dive, remove a little of the counterweight, and if it will not nose at all, add to the counterweight.

This model can be dropped off a high building or released from the top of a hill. The distances of the glides can be measured and by this means contested with other models.

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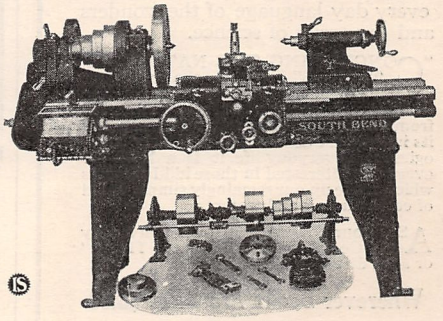

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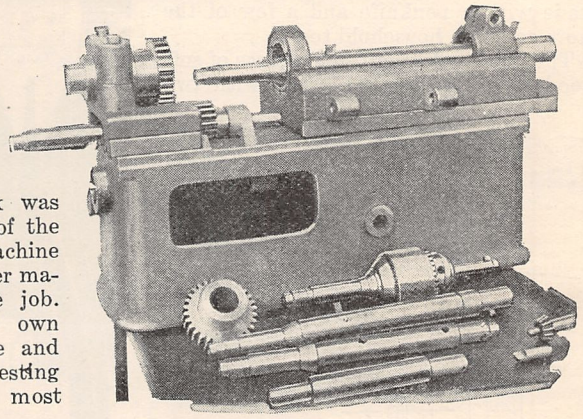
Better Shop Methods

(Continued from page 84)

How You Can Make the Most Out of Your Milling Machine

By O. S. Marshall



ALL the major operations of planing, milling, and boring that were performed in building this machine (Fig. 1) were done on a small milling machine. Normally this work was beyond the actual capacity of the miller, which was a duplex machine of a familiar type, but no other machine was available for the job. The illustrations tell their own story of how this was done and may prove helpful in suggesting ways in which to make the most of a miller.

In Fig. 1 the machine is ready for scraping the bearings and final assembly. The saddle and headstock are in position, and all the special boring bars that were made for the boring operations are shown. The boring bar for the saddle reclines in the finished spindle holes.

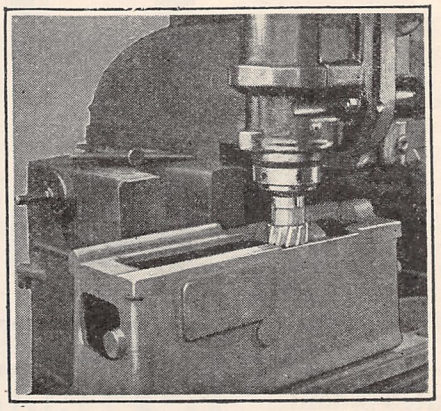


Fig. 1 (above)—Every major operation of planing, milling, and boring on this machine was done on a small miller, which ordinarily would not be considered large enough to handle the work. Some of the special tools used also are shown

Fig. 2 (at left)—The machine bed in position for roughing out the saddle-ways and later the V's in use in Fig. 3.

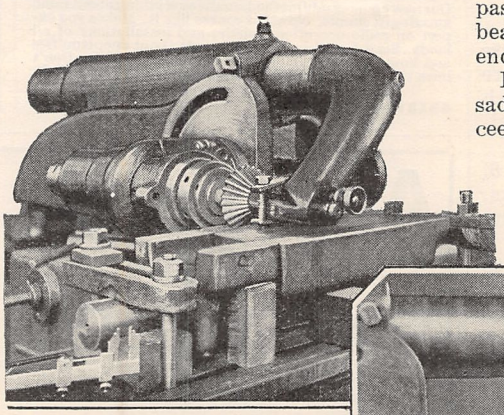
Referring to the other views, the sequence of operations was as follows: The castings were roughed out by the milling machine, wherever they were to be finished, to insure perfect alinement in the machining operation.

The bed was surfaced on its under side, then set in position (Fig. 2), and the saddle-ways were roughed out with an end mill. As the head of the miller may be set at 45 degrees, the same end mill also served for roughing out the V's. These were finished, however, with the double-angle, 90-deg. cutter shown in Fig. 3. The saddle and the headstock were bored to the required diameter of 2.047 in. and then mounted, as shown in Fig. 3, on the arbor and supported in a pair of V-blocks.

The blocks were milled in position at the V's to insure their perfect alinement with the path of the platen as the work passed beneath the cutter. The flat bearing of the saddle was milled with the end mill in vertical position as in Fig. 2.

Figure 4 shows the boring set-up for the saddle. Normally, the operation exceeded the capacity of the cross feed of the miller. This contingency was met by using two fly-cutters, spaced so the two would operate simulta-

(Continued on page 105)



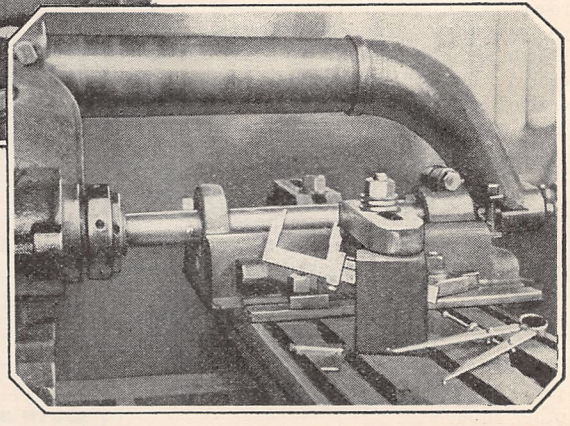


Fig. 3 (above)—Finishing the V's and, Fig. 4 (at right), boring the saddle by using two fly-cutters

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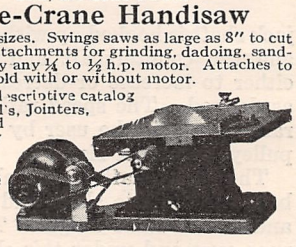

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Better Shop Methods

You Can Make the Most of Your Milling Machine

(Continued from page 105)

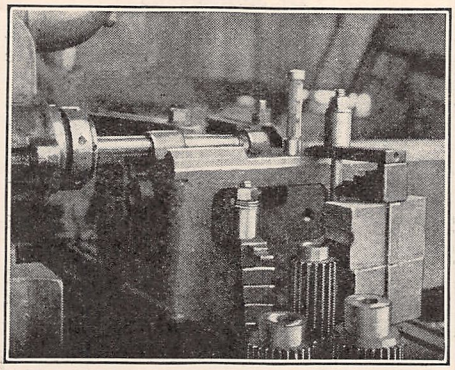

Fig. 5—Using a hole already finished in the bed to aid in supporting a boring bar

neously, while the boring bar was supported at its outer extremity by the overhead arm. The faces of the left-end spindle hole required to be faced, done with a fly-cutter at the same setting.

Boring out the bed (Fig. 5) presented the greatest difficulties, but these were overcome. The holes were cored out, except the upper one, which is shown under the boring operation. This hole first was drilled on an upright press, leaving sufficient for finishing on the miller. The bed then was clamped on the miller and lined properly in relation to the finished saddle-ways. The first hole, at the outer end of the bed, was bored to size, using the drill chuck and fly-cutter shown in Fig. 1. A boring bar was used for boring the inner hole, the bar being supported by having it fit the hole already finished.

In order to insert and remove this boring bar, as well as the one for the under hole, the platen of the miller was set by a stop, so that it could be run along far enough to allow the removal of the bars and their replacement with accuracy. The graduated dial of the longitudinal feed also was set to zero at the boring position to insure exactness.

Other operations were performed, but followed the same principles.

The upper hole in the bed is 1 in. in diameter, and the bearings are about 5 in. apart, squared up on their inner hubs. The lower hole is 1¼ in. in diameter, and the two bearings are about 6 in. apart, with all four hub faces finished with fly-cutters at the boring position.

The center distances between these holes are 2½ in. for the gear train, two of which are shown in position in Fig. 1. The bed is 22 in. long, 9 in. high, and 7 in. wide. The saddle is about 15 in. long.

With the addition of the special boring bars, the small miller adequately handled all the boring, milling, and planing operations.

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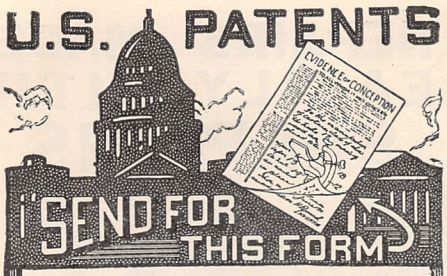

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Better Shop Methods

Old Bill Machines a Crankshaft

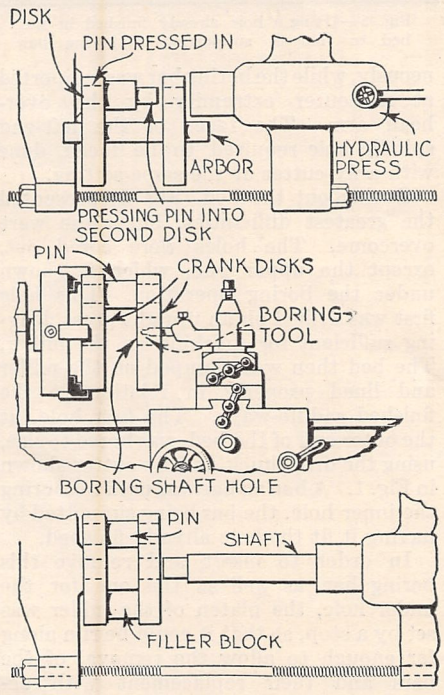
By James Ellis

OLD BILL came into the shop behind a truck bearing two castings. He called Bob Laten.

"Here are the castings for that crankshaft we have to make for Berry's mill," he said. "The broken one is over in the pattern shop, but I will have it brought over here for you."

"Are we going to use the old shafts?" Laten asked.

"I thought that we would get along much better if we used new shafts and a new pin," said Old Bill. "The new apprentice was roughing out the shafts. I suppose they are done now. I have saved the nice part of the job for you."



After the crankshaft pin is pressed into place, both shaft holes are bored at one setting

Old Bill smiled broadly as he said this.

"It sounds just like you!" Laten retorted, "to keep all the hard work for me!"

"Well, I have a scheme for doing a job like this that I will tell you about," Old Bill said. "It may make it a lot easier for you.

"The first thing to do is to rough turn both of the disks and to rough bore the shaft holes. Now drill a couple of holes through them so that you can bolt both disks together while you are boring the pin hole and the shaft hole. While they are clamped together you can cut the key seat in both at once. Now fit the pin.

"Then make an arbor, or take a smooth piece of shaft that will be a free sliding fit in the shaft holes. Use this to maintain the alinement of the disks when you are pressing in the pin. Press the pin in one side first, then put your arbor in the disk, and the other disk on the arbor, and press it on the pin.

"Take out the arbor, take the assembled pieces to the lathe, and true them up carefully. In spite of all your care, the chances are that the disks will not be true with each other. That is all right, for now is the opportunity to correct it. Bore out the shaft holes in both of them at one setting. Then you can be sure that when you press the shafts in, they will be in line, provided that you do not spring the pin. To keep from doing that, you must fit a block to go between the disks so that it just fills the space."

"I might use a jack in there," Laten suggested.

"No, you can't use a jack!" responded Old Bill. "Get a piece of shaft, or a chunk of casting and face it to tap between the disks. If you were to use a jack, you would have a bearing on only a very small area, and the casting might crush enough to let the pin bend just a little, and that is what we want to prevent. Use something that will give you a considerable area, for we want to put those shafts in with about 20 tons."

"I see the idea," Laten agreed.

"Then, after you have it all together, you can finish the shafts to size and turn the outside of the disks," Old Bill continued. "When you are through, you will have the whole thing perfectly true. You will be surprised at how little time all this complicated proceeding takes."

Jack Shaft Used to Provide Additional Lathe Speeds

ON MOST engine lathes driven from a countershaft the usual range of speeds is eight—four with open belt and four with the back gears in. This is where one of the belts from the line shaft is used for reversing.

Eight additional speeds can be had by having both belts from the line shaft straight and using a larger driving pulley for one.

A still greater variety of speeds can be provided by the method illustrated. A jack shaft is hooked up with the line shaft and the countershaft and can be used either to increase or decrease the speeds as desired. The speed ratios can be arranged to suit the user by installing the pulleys of proper size.

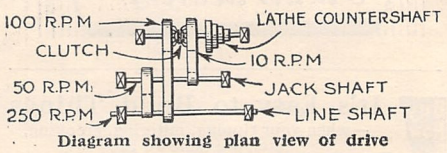


Diagram showing plan view of drive

The jack shaft is set about halfway between the line shaft and countershaft and at the same height. The long belt runs over and under this shaft.

The additional speeds obtained in this way come in handy on many jobs and save time in changing into back gears to get a lower or higher speed when additional power is not needed. A shift from one clutch pulley to the other will instantly change the speed from low to high.—H. L. WHEELER.

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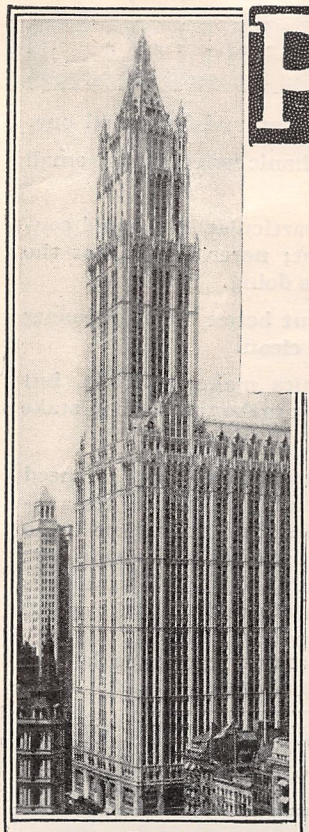

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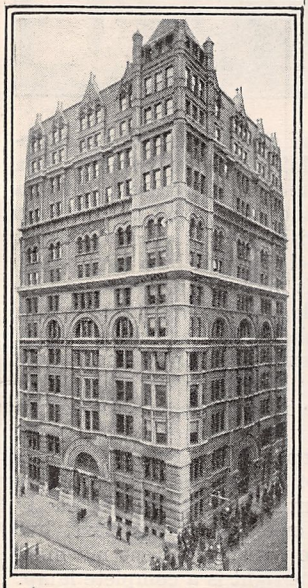

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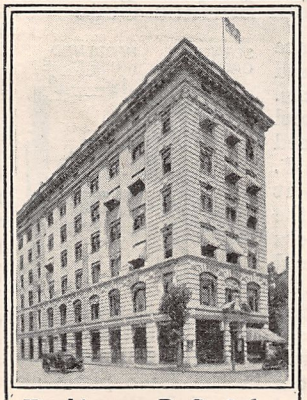

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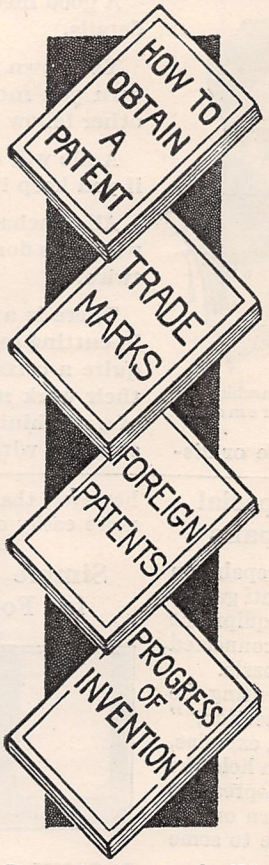

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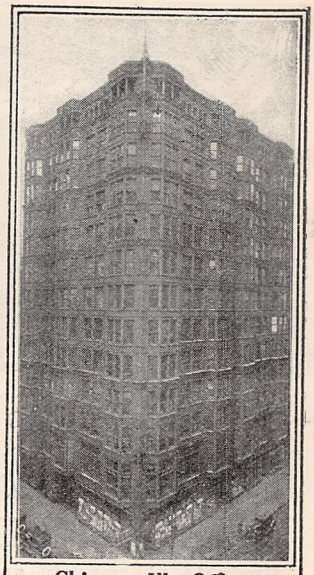

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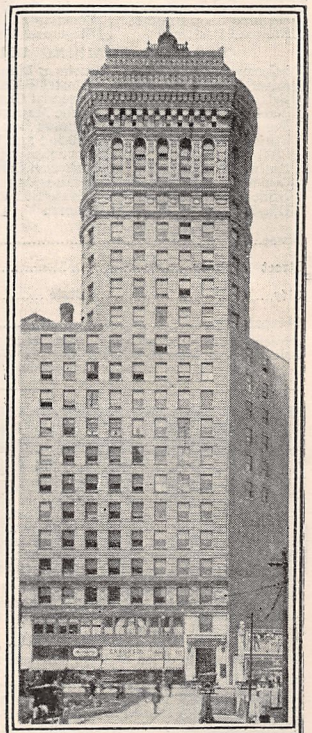

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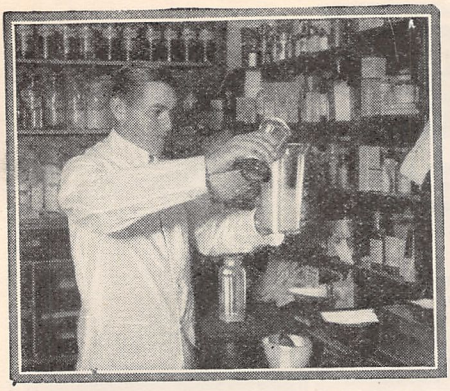

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AGENTS Here's a money maker. Everybody wants one. Splendid profit. Write for special offer.

Better Shop Methods

Old Bill Says—

Old Bill, machine-shop foreman

WHEN dipped in hot soda, finished work will not rust.

You won't be so apt to make mistakes if you have plenty of confidence in yourself.

If a tool or a drill is soft, it is a waste of time trying to make it cut. Have it tempered at once or discard it and look around for a good one.

A good mechanic never slights small details.

Your own particular job should concern you most; never mind what the other fellow is doing.

A file will cut better and last longer if you keep it clean.

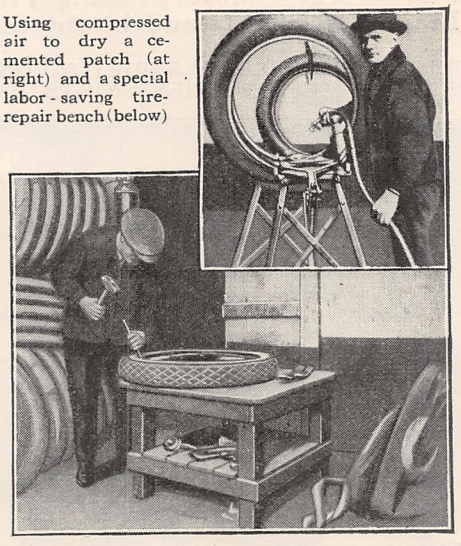
All mechanics make mistakes, but wise ones don't make the same mistake twice.

There is a reasonable limit to speed in cutting metal. All cutting tools require a certain amount of time to do their work most efficiently. One part of a machinist's job is to keep the tools supplied with work at the right speed.

Compressed Air and Special Bench Speed Tire Repairs

TO DRY quickly cemented repairs on automobile tires, a Cincinnati garage uses compressed air. The equipment consists of an ordinary hose connected with the air tank and a tin nozzle.

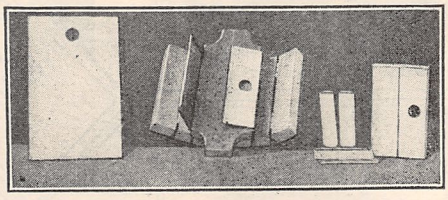
"On a 'job' that requires cementing the inside of a tire, for a so-called 'section,'" William Bothwell, of this garage, explains, "we apply the cement—and then hold the patched place apart with wooden spreaders of the usual type. Then we turn on the compressed air, fixing the nozzle to some object near by so that it will play steadily on the cement. We keep 140 pounds pressure in the tank, and turn on enough air to give what amounts to a stiff breeze. After letting the air play for perhaps 15 minutes while we busy ourselves with other things, the cement is dry! We apply two coats in half an hour."



Using compressed air to dry a cemented patch (at right) and a special labor-saving tire-repair bench (below)

The same garage is equipped with a 3 by 3 ft. pine bench, 2½ ft. high, for speeding up tire changes and many repairs. Tiremen elsewhere do much repair work on the floor because they feel that a tire on the floor, held with the foot, is in a firmer position. Mr. Bothwell has found, however, that most repairs can be done more easily on a bench.—FELIX J. KOCH.

Simple Wooden Tools Used for Folding Sheet Metal

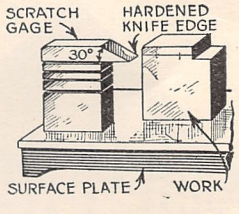


MANY small sheet-metal jobs that require folding can be handled in a simple tool like that illustrated. It is a sheet-iron folder for making oil-lamp founts used with hog waterers. Without this special tool it would be a slow job.

The folder is made up of pieces of 1½-in. hard maple, hinged together. The bottom is a solid piece and has one dowel pin in each corner to keep the core from moving out of place. A sheet 10 by 16 in. is put in place over the folder, the core is laid on top of this, the sides are brought up, and the top is pressed down.

At the left of the illustration is the plain sheet; the center view shows one partly folded. The ends are shown next, but they are made with a different machine. At the extreme right is a complete lamp.—WALTER L. CROWE, Paullina, Ia.

Precision Surface Gage



THIS surface gage is used with gage blocks. It is made of tool steel, hardened and ground. Lengthwise it projects over the end of the blocks about ¾ in. and is beveled to a 30-deg. angle. The bottom or contact surface is lapped to a wringing fit with the gage blocks, and the cutting edge is hone with great care so that the marking point is in the same plane as the contact surface.—H. L. W.

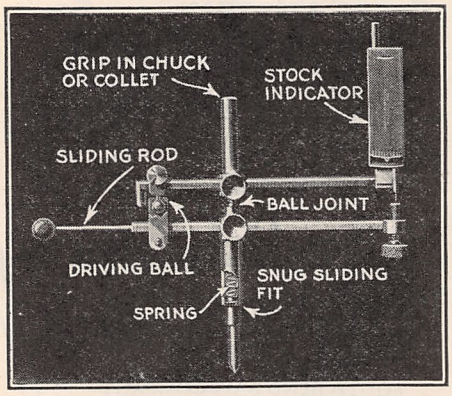
Better Shop Methods

Indicator Attachment for Lining Up Stationary Work

By Charles Kugler

THE indicator attachment shown below is a handy tool for lining up center-punch marks on many kinds of jobs in a drill press, milling machine or other machine tool where the cutting tool rotates and the work remains stationary. With this attachment it is possible to adjust a center-punch mark in a layout to within .001 in. in relation to the true center of the spindle.

Simplicity of operation and construction are the main features of the design. The horizontal rods are of drill rod and have a flat on one side for the binding screws of the shank and point holders. These members are turned from square stock, with a short portion left square on one end of each piece. The lower end of the shank and the upper end of the point holder have a reamed hole, which is a nice sliding fit on the rods. Thumb-screws



If the point is not in line with the spindle, the indicator at once shows the discrepancy

are provided to lock them after the correct setting has been secured.

In operation the attachment is gripped in a drill chuck and the center-punch mark is brought into approximate position by the eye. The point of the indicator attachment then is set into the mark. At the same time the table is raised or the spindle lowered sufficiently to allow the spring to balance the indicator pointer without undue pressure or friction.

By moving the work until the rods are nearly parallel, the lower pointer will reach a true perpendicular. The attachment then is adjusted until the pointer of the indicator stands at zero, when it is locked in position with the thumb-screws.

Revolve the spindle one-quarter turn, note the reading of the indicator, and take readings at each quarter turn for one whole revolution. If the indicator pointer remains stationary through a whole revolution, the position is correct. If any variation is noted, the error is compensated by adjusting the work until the indicator point remains stationary. The accuracy of the drill chuck used for holding the attachment in no way affects the results obtained.

The lower horizontal rod is drilled nearly its entire length for a sliding rod and ball. This is used to balance the instrument in any position, such as when used horizontally in a lathe or boring mill.

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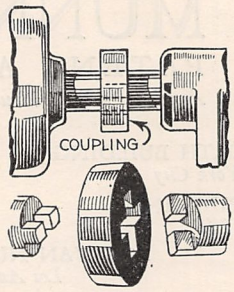

The shaft ends and coupling ring

Each of the connecting parts has square projecting ends with the center sections removed. It is possible to leave one center in, however, where end movement is limited.

A loose ring with cross slots to correspond to the projecting lugs on the shaft ends engage the lugs. The slots are only a fraction of an inch longer than the width of the shaft projections—just beyond the limits of possible movement between the ends of the shaft.

The ring can be made into two parts, if desired, and held with screws, to permit the coupling to be made after the shafts are placed and fastened.—G. A.

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IN SHOPS where a great deal of shaft straightening has to be done, it is economical to have a special rig for handling the work. A good lathe will be ruined in a short time if the work is done on centers in the old-fashioned way.

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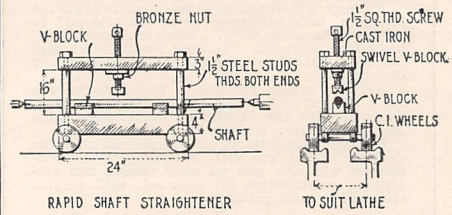

Side and end views of the straightening fixture, which rolls on the lathe ways

the design may require modification to suit local conditions.

The base and top are flat cast-iron pieces 24 in. long. The base, which is somewhat heavier than the top, is planed on the upper side. Two steel V's are used to support the shaft; they may be set in or out as desired for a long or short bend.

The height of the V-block and the diameter of the wheels should be such that a 4-in. shaft will come about on the centers. For smaller shafts, packing can be used.

The shaft is rotated on the centers by hand and then dropped into the V-block after the fixture has been rolled along the ways until the screw is over the kink to be straightened.—H. L. W.

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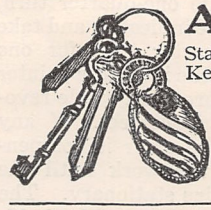

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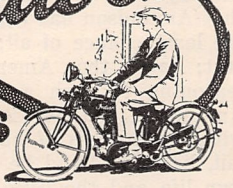

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Here Are Correct Answers to Questions on Page 67

1. The lungs of an average man will hold about 10 pints, but they are seldom as full as this unless a very deep breath is taken. Usually they hold about six pints. People ordinarily breathe about 20 times a minute, using about 20 pints of air a minute or 150 gallons an hour.

2. Possibly a small amount of energy is used up by nerve cells in passing along messages of any kind, but it is much less than a hundredth part of the energy used by muscle cells when they work. Continued mental effort does not tire us because of the energy used up in thought itself, but because of the continued muscle strains—the strain of the eye muscles in reading, or of the ear in hearing lectures, or of the general body muscles in holding themselves still and tense when we are very intent on something.

3. At the lower end of the human backbone there are six extra bones or vertebrae which are separate in babies but fuse together in later life into two more or less solid bones. They are useless to us and are buried in the flesh of the back so that they cannot be seen except in a skeleton or by X-rays. These, scientists believe, are vestiges of the tail bones.

4. The water on the finger instantly is turned into steam and this little layer of steam keeps the finger from coming actually against the hot iron. The protection is only for a moment. If you hold your finger on the hot iron for more than a very small fraction of a second, you will be burned.

5. Put a tiny drop of nitric acid on the back of it somewhere. If it is platinum it will not be affected at all. If it is silver the acid will boil and turn brown and a black spot will be made on the metal. Wash off the acid at once or it will dissolve the silver altogether.

6. Because it is a mineral and incombustible, as nearly all minerals are. As it occurs in fibers, it can be spun and woven and made into cloth or paper or felt-like sheets.

7. Probably there would be so much heat produced by the smash that even the rocks would be turned into gas. Fortunately, the chance of this happening is a very small one. Remember that the nearest known star is nearly 26 trillion miles away.

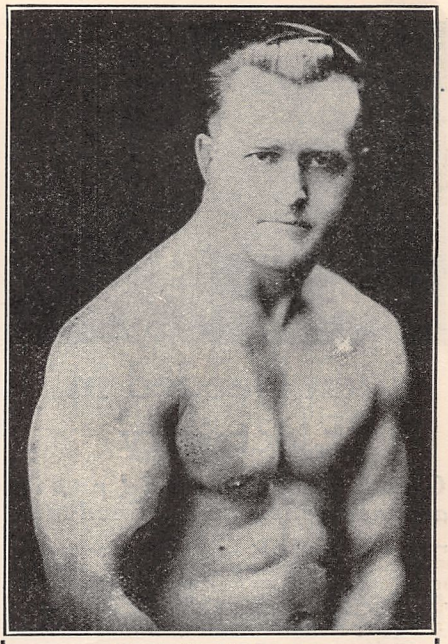
8. Water carrying in solution silica, or quartz, saturates the body of the tree and replaces each little bit of wood with quartz. The whole tree thus is turned to stone.

9. The animals they keep are not really like cows, but are little insects, called "aphids," that live on plants and produce a sweetish liquid the ants eat.

10. All ether waves are believed to be alike except for length. Radio waves are the longest; next the heat waves; light waves; the waves of ultra-violet light and of the X-rays; finally the gamma rays of radium, which are the shortest ether waves now known.

11. Because the fibers in it are woven together very loosely, so that the paper is porous. This makes millions of tiny holes inside the paper into which the water can be soaked.

12. If there were any air inside the bulb, the hot tungsten in the filament would combine with the oxygen of the air and burn up, just as a cotton thread would burn up in a hot furnace.



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It's not too late. Snap into it and I can save you yet. It means hard work and plenty of it, but—wait till you see the results.

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My job is to build muscle. That is why they call me The Muscle Builder. In just 30 days I am going to add one full inch to your biceps. Yes, and two inches on your chest in the same length of time. But that's only a starter. I am going to broaden out those shoulders and shoot a quiver up your old backbone. I am going to put a man's neck on you and a pair of legs to balance the strong sturdy body they support. You will have a spring to your step and a flash to your eye, radiating the dynamic life within you. Before summer is past you will never recognize your former self. You will have a strong, sturdy, virile body to be really proud of. You will be admired for your perfect manhood—while others are given glances of pity and scorn. This is no idle prattle, fellows. I don't just promise these things. I guarantee them. Are you with me? Let's go. Time is short and we have a job to do.

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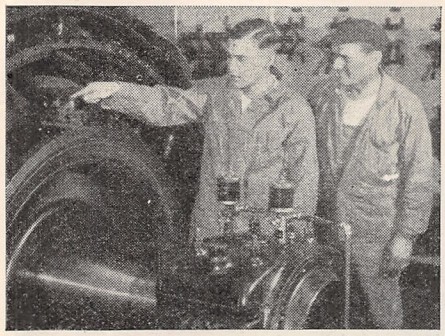

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Three Nations Racing for the Pole

(*Continued from page 30*)

MacMillan expedition. This is the first time in the history of arctic exploration that such an agency of rescue has been available.

One need look back only a few months to the round-the-world flight to realize the tremendous importance of tireless, painstaking attention to detail in difficult aerial navigation. The U. S. Army fliers successfully completed the task of encircling the globe because they had prepared, planned, arranged their schedule to the minutest detail and then adhered to it slavishly. The British and Italian efforts to circumnavigate the earth by air failed because there was lacking the meticulous attention to minute details; the foresight that took into account remote contingencies of mishap and prepared for them in advance.

THAT is one reason why I venture to predict now that MacMillan ultimately will win the race.

A glance at the map indicates an obvious reason for the American explorer's choice of an itinerary. The north end of Axel Heiberg Land is slightly closer to the Pole than Amundsen's base—less of hopeless desert to travel in case of smash-up.

But that isn't the inner secret of MacMillan's choice. And this is where an even deeper significance of the great race comes in. For they are not racing for the Pole after all—none of them. The Pole is just an *excuse. Three nations are racing for the last undiscovered continent on the surface of the globe!*

How do we know there is such a continent? We don't know. Which adds that much more zest to the chase. All we do know is that there lies above Alaska—*our* Alaska, mark you—the greatest unexplored area on the earth: 1,000,000 square miles as yet untrod by man. There are strong indications that this area may contain land. Eleven years ago MacMillan and the writer crept outward over the torn ice northwest of Axel Heiberg Land in search of this land. The unknown area was penetrated to a depth of 162 miles; but only more ice lay beyond when dying dogs forced retreat.

TODAY the mystery is still unsolved, unless by this moment one of the racers stands there, head uncovered, eyes tear-filled at the sight of his homeland's flag floating over a new-found territory.

All entrants and their governments admit that the chance of new land being discovered is good. So it may be that the stake of the great race is truly priceless. The land may not be full of material treasures; though that is not impossible. Judging from other lands abutting on the Polar Sea it may well contain rich deposits of ore, coal, helium, and so on.

Sport should not know tragedy; but the present race may have its dark side. Amundsen, Algarsson, and MacMillan are a daring lot. It will be like them to urge their pilots onward when the first gusts of a gale are stirring the powdery snow below. A lost entrant cannot win.

This phase of the struggle opens up an entirely new viewpoint. By it we see that Amundsen has what may be termed the least chance of all; the British next best; and the Americans best. The reasoning to such a conclusion is that Amundsen's success is sewn up utterly with the success of his planes. If they fail, he fails. And he stands to lose his own life and the lives of his men. His men will have had no arctic experience to speak of. Once down on the ice one sees them soon paralyzed by the raw cold of the arctic summer and hundreds of trackless miles to go for game or solid land.

THE British are better off in that Algarsson is to have a small dirigible. He sailed with 30 tons of gas cylinders or 50,000 cubic feet for inflation.

If Algarsson goes adrift in a blizzard, or reaches the Pole and new land at the expense of all his fuel, he can sit tight and take a chance on drifting home. Polar air currents are generally southward owing to the "descending gradient," or cooled air that falls in high latitudes and rushes southward to take the place of that rising over tropical regions. Provided food does not give out, Algarsson has a pretty good chance of winning, no matter what happens. And the British are pretty good *stickers.*

The trouble is Algarsson's blimp won't carry enough food for a long drift.

From the angle of possible disaster MacMillan is thus the surest bet of all. MacMillan knows the Smith Sound Eskimos. He will use them as a school for his assistants. In the long winter night he will have his men learn the art of building igloos from the native hunters; and how to keep one's feet from freezing at 60 degrees below zero; and how to find game where there isn't any game—or where the average man wouldn't see a trace.

MACMILLAN will enlist the aid of a dozen picked hunters from the 235 members of the little tribe that made Peary's feat a possibility. He knows they have never seen a flying machine. He realizes that they think the white man is an interesting lunatic. He knows, too, that they are quick to learn; courageous and adaptable; and most of them can master a new tool in half the time it takes a white man. He may even take a group of them to his advance base if he can persuade them to fly there. If not, he will surely get them to sledge there. With a handful of dogs one of these hardy aborigines could keep a dozen men alive on the plentiful game in Ellesmere Land, working gradually back through the country to Smith Sound and Greenland.

Curious, isn't it, how the prospects run? An airplane race; a contest between the most miraculous machines that man has ever devised; machines that mark our conquest of the air. Yes, an airplane race, and the greatest race in history; and all that. Yet when we come to analyze the problem, it really looks as if the winner may win simply because he has learned from a little tribe of stone-age natives how to kill a seal on ice and how to keep his feet warm while he's doing it.

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A Good Four-Tube Receiver

(Continued from page 69)

for 62 turns. This completes tuning unit *A*, *B*, which is really one continuous coil of 70½ turns, with a tap 8½ turns from the lower end.

Tuning unit *C*, *D* consists of two coils wound close to each other so that they look like one continuous coil. The holes to hold the end of coil *C* are ⅝ inch from the lower edge and the upper end of this coil is brought out on the opposite side of the tube 1⅛ inch from the end of the tube, making 14½ turns. Coil *D* starts at the same distance from the end and consists of 62 turns with a tap at the 20¼ turn as shown in Figs. 1 and 5. All coils should be wound in the same direction,

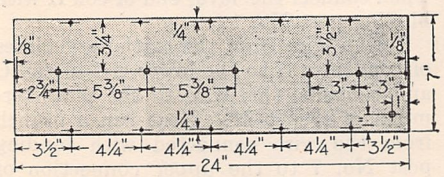


Fig. 6—A panel diagram, with the exact measurements for laying out and drilling holes

beginning at the lower end. The spacing is for No. 22 double silk-covered wire wound very carefully without kinks. If you have not had much experience in winding coils, it will be well to allow yourself a little more space. It is important to have coils *B* and *D* as nearly alike in spacing as possible so that the tuning condensers *E* and *F* will read practically alike at the different wave-lengths.

When you twist the wire for the tap, it is a good idea to put a little piece of paper underneath the wire at this point so that there will be no chance for the kink in the wire to press through the insulation on the turn next to the tap. One short-circuited turn will completely spoil the operation of the receiver.

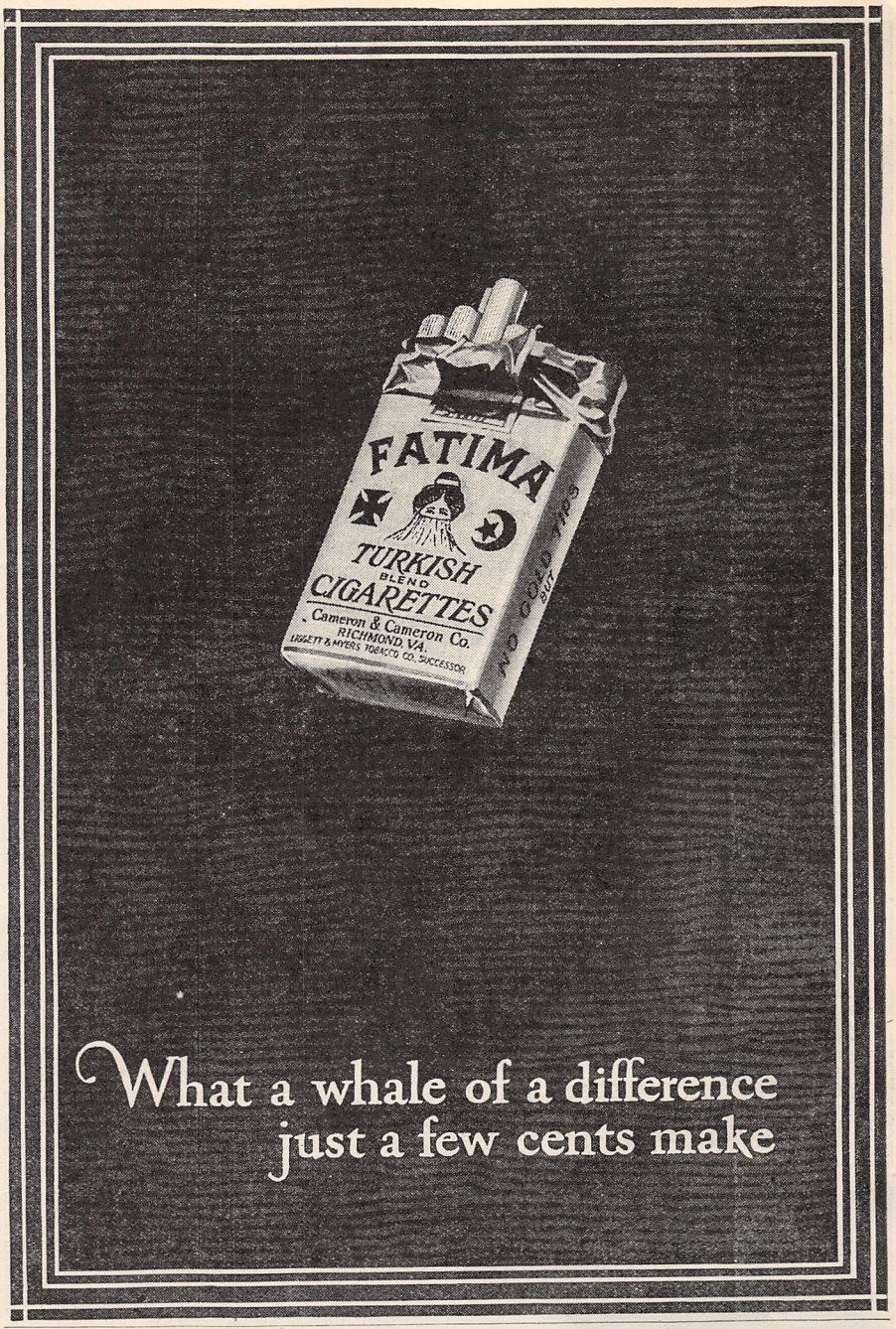
After you have the tuning units and the brackets completed, study Figs. 1, 4, and 5 very carefully and then mount the various instruments on the baseboard. When you are satisfied that you have them all mounted correctly, it is a good idea to remove the tuning units and lay them aside until you have the wiring completed to the point where you want to connect them into the circuit.

THE sockets should be placed with the filament terminals nearest the front panel and the transformers *K* and *L* with the *G* and *P* terminals also toward the panel.

The tuning units *A*, *B* and *C*, *D* should be mounted at an angle of 57 degrees with the baseboard and they should be 6¾ inches apart. The angle should be correct within a degree and if there is any error it is better to have the angle include a less, rather than a greater number of degrees. Another receiver built along the same lines worked nicely with the coils set at an angle of 55 degrees.

Begin the wiring with the filament circuit. Connect the left-hand filament terminal of sockets *N*, *O*, and *P* with the right-hand terminal of socket *M* (as seen from the rear,) and run a branch from this wire to either terminal of the rheostat

(Continued on page 114)



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Philadelphia, Pa. Dept. 1929, Kansas City, Mo.

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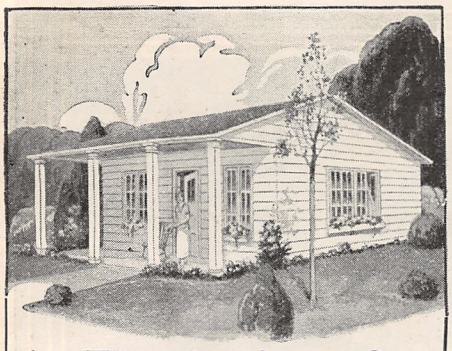

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This is the greatest value in Bungalows ever offered. Delivered to you complete, can be easily erected by two men within a day and a half. No skilled help necessary. Can be taken down quickly, transported and put up again without trouble. Sturdily built, will last for years.

Only $615 F. O. B. Bklyn

Living room, 12 ft. x 12 ft. 2 bedrooms, 9 ft. x 9 ft. Kitchen 6 ft. x 9 ft. and bath. Perfect room arrangement, light and airy.

RIGHT NOW send for order form and free folder completely describing this greatest of bungalow values. **Houses in stock, ready for immediate shipment.**

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This handsomely designed garage comes sectional-built, 12 ft. x 18 ft; inside measurements. Strongly constructed. An attractive addition to any home or estate. Can be erected by unskilled labor in 8 or 10 hours. Carried in stock for immediate shipment. ***Write at once for free descriptive folder.***

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Makers of the Famous World Radio "A" Storage Battery
Prices: 6 volt, 100 Amp. $11.25; *100 Amp.* $13.25; *140 Amp.* $14.00
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Saves $10 to $25 on the Ranger Bicycle you select from **44 Styles,** colors and sizes. Delivered free on approval *express* prepaid for **30 Days' Free Trial.**

$5 a Month if desired. Possession and use at once on our liberal Monthly payment plan. Bicycles **$21.50** and up.

Tires lamps, wheels, equipment at half usual prices. Write for marvelous new prices, wonderful 30 day trial offer and terms.

Mead CYCLE COMPANY DEPT. A250 CHICAGO Write us today for free catalog

A Good Four-Tube Radio Receiver

(Continued from page 113)

Q and from the other terminal of rheostat *Q* run a wire to binding post No. 3. Next connect the remaining filament binding posts on sockets *M*, *N*, *O*, and *P* and run a branch from this wire to binding post No. 4 and also connect binding post No. 5 with No. 4. This completes the filament wiring.

The next step is to wire the audio-amplifier end of the circuit and with the filament wiring finished, this is a very simple matter. First run a wire from the plate terminal of socket *N* to the rotary-plate connection of variable condenser *G* and from this wire run a branch to the *P* terminal of transformer *K*. Connect the grid terminal of transformer *K* with the grid terminal of socket *O*, and continue the wire over to one terminal of variable resistance *R*. Now connect the plate terminal of transformer *L* with the *P* terminal of socket *O*, and connect the grid terminal of transformer *L* with the *G* terminal of socket *P*. Next connect the *P* terminal of socket *P* to one terminal of jack *T*.

CONNECT the B-plus terminal of transformer *K* with binding post No. 6 and run a wire around from the remaining terminal of jack *T* to binding post No. 7, with a branch going to the B-plus terminal of transformer *L*.

In the model receiver shown in the illustrations, the C battery is not held in place by brackets. It simply is placed near the edge of the baseboard and connected by means of flexible wires as shown. Run a branch from the wire that is connected with binding post No. 3 and cover this wire with spaghetti, so that if you move it around accidentally while connecting the C battery, there will be no chance of a short circuit with the wires coming from binding posts Nos. 6 and 7. This wire is to be connected with the plus binding post of the C battery. Next, run a flexible wire from the *F* terminal of transformer *K* to the 3-volt tap on the C battery and a flexible wire from the *F* terminal of transformer *L* to the 4½-volt tap.

In the test at the Popular Science Institute of Standards laboratory it was found that this arrangement gave a shade louder signals than any other. The proper C-battery voltage depends, however, on the tubes, audio transformers, and B-battery voltage you are using, and you may find that for your own conditions a better arrangement is to connect the flexible leads from both transformers with the 4½-volt tap.

Complete the audio-transformer wiring by connecting the remaining terminal of variable resistance *R* with the wire that goes to rheostat *Q*. It makes no difference whether this connection is made with the socket side or the battery side of the rheostat.

Next, connect the rotary-plate terminal of variable condenser *E* with the right-hand filament binding post of socket *M* (as seen from the rear) and also connect the rotary plates of condenser *F* with the right-hand filament terminal of socket *N*.

Now fasten the tuning units *A*, *B* and *C*, *D* back in place and proceed to connect them with the circuit. First run a wire from the tap on *A*, *B* down to the wire that is connected with the rotary plates of condenser *E*, and also run a branch from this latter wire to binding post No. 2. Now connect the stationary plates of condenser *E* with the top end of coil *B* and from this wire run a branch to the *G* terminal of socket *M* and continue it on to one terminal of balancing condenser *J*. Then connect the lever end of coil *A* with binding post No. 1.

Run a wire from the stationary plates of condenser *G* to the lower end of coil *C* and continue this wire to the plate terminal of socket *M*. Next run a branch from the wire connected with binding post No. 7 to the upper connection of coil *C* that comes out toward the back of the receiver. After this, connect the lower end of coil *D* with the wire that goes to the right-hand filament terminal of socket *N* (as seen from the rear). Connect the tap on coil *D* with the remaining terminal of balancing condenser *J*.

Next connect the stationary plates of condenser *F* with the top end of coil *D* and run a branch down to one end of grid condenser *H*. The other end of grid condenser *H* is, of course, connected with the grid terminal of socket *N*. The wiring is now complete.

To put the receiver into operation, connect the antenna, ground, and batteries as indicated in Fig 2. Then, making sure that rheostat *Q* is turned off all the way, insert the tubes in sockets *M*, *N*, *O*, and *P*. The constants of the circuit are right for standard storage-battery tubes. Dry-cell tubes may be used, but you may find it necessary to increase the number of turns in coil *C* from 14½ to as high as 20½, depending on the type of dry-cell tube you use.

Plug the phones or loudspeaker into jack *T* and turn on the rheostat *Q* carefully until the tubes light dimly. Then turn condensers *E* and *F* slowly until a signal from a local station can be heard. Keep both condensers at about the same reading on their dials. The dials should, of course, be set so that the reading is highest when the plates of the condensers are engaged fully.

AS SOON as a signal is heard, adjust *E* and *F* until it is as loud as possible with *G* set at zero. It is preferable to tune in a station that comes in at about 20 degrees on condensers *E* and *F*, and when you have the signals from a local station as loud as possible, you can proceed to adjust the balancing condenser *J*. You probably will find that the receiver has a tendency to howl on the lower wave lengths, just as the signal is brought to the loudest point, and this howling can be eliminated only by a proper adjustment of *J*.

(Continued on page 115)

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A Good Four-Tube Receiver

(*Continued from page 114*)

There are two ways to adjust *J*. One is to set *E* and *F* where the howl occurs at 20 degrees or lower and change *J* until the howl disappears. The other and better method is to turn off the tubes after the local station is tuned in as loudly as possible, take the tube out of socket *M*, and replace it with a piece of paper over either prong that makes contact with the filament circuit. Then turn on the rheostat carefully and, with a pair of head phones on, adjust *J* until the signal disappears or is as weak as possible.

If you use one of the midget Vernier condensers at *J*, mount it so that the shaft is vertical and saw a slot in the knob so that the condenser plates can be turned with a wooden-handled screwdriver while the signal is coming in. If you use the type shown in the model receiver, it may be necessary to connect the center tap of the balancing condenser with the end toward the audio transformers. The capacity of the glass-tube type of balancing condenser also can be increased by turning it end for end or using larger wire inside the tube. At any rate, you can tell whether more capacity is needed easily enough. If, when you are using the second method for balancing, the signals become weaker right up to the end of the adjustment and do not increase again, then more capacity is needed. The nickel-plated sleeve should be moved with a wooden stick to avoid hand-capacity effects.

After the receiver is balanced, all tuning is done with condensers *E* and *F*. *G* controls regeneration, and if you wish to hunt for stations, the easiest way is to turn *G* up until there is a click in the phones or loudspeaker, and then turn *E* and *F* slowly, with *E* always a few degrees lower than *F*. When a whistle is heard, adjust both dials so that it is as loud as possible and then turn *G* toward zero until the whistling stops. Then the signal will come in clearly and without distortion.

R is for use in controlling the volume on local stations or distant stations when they happen to be coming in too loudly. The more the knob is screwed in, the weaker is the signal. It will reduce even local stations to the point where head phones can be used.

Recent Publications

A Résumé of the Latest Books on the Sciences

Ships of the Seven Seas, by Hawthorne Daniel. A colorful description of ships, from the earliest Egyptian craft to the giant liners of today, written for the layman. Illustrated. Doubleday, Page & Co.

The Heavens, by J. H. Fabre. Teaches astronomy in simple stages, leading from every-day observation to clear explanation of the most difficult movements of the stars. Illustrated. J. B. Lippincott Co.

The Modelmaker. A collection of designs for locomotive, ship and engine models, and helpful notes for those interested in making working models. Illustrated. Spon & Chamberlain.

"pep up" *your radio*
for good summer reception
JEFFERSON
TUBE REJUVENATOR
keeps tubes like NEW!

YOU can't get good summer reception with weak tubes. All radio tubes weaken with use—especially in summer when burned at higher voltage. Keep *your* radio tubes efficient this summer with the Jefferson Tube Rejuvenator. Just attach to a convenient electric light socket—"bring back" each tube in 10 minutes!

Repeat once a month—note how it improves reception; DOUBLES and TREBLES tube life, and saves batteries. It's wasteful to be without one; it's economy to own one. Takes large or small tubes—201-A, 301-A, UV-199, C-299. Fully guaranteed. Get yours now. At leading stores selling radio. If your dealer can't supply you, send $7.50 to

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Makers of Jefferson Radio, Bell Ringing and Toy Transformers; Jefferson Spark Coils for Automobile, Stationary and Marine Engines; Jefferson Oil Burner Ignition Coils and Transformers.

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Elto
Ole Evinrude's New Quick Detachable ROWBOAT MOTOR

Get more fun out of your vacation this year. Take the thrill of motor boating with you wherever you go. Elto attaches instantly (without tools) to any boat. This wonderful little 3 H. P. Motor is—

FAST—POWERFUL
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Weighs less than 17 lbs. per H.P. Has these exclusive features — Propello Pump, Instant Easy Starting, an Extra Horse Power, Much More Speed, Safe Rudder Steering, Fits Carrying Case without taking apart.

Write for FREE Catalog
See how easily you can own an Elto. See why it is the safest Motor for all the family — the fastest on the water, and the easiest to start. Write today.

ELTO OUTBOARD MOTOR CO.
Manufacturers' Home Bldg.
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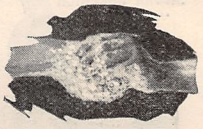
The Motor that Starts with a Touch

Removes Grease and Grime *Without Water*



Have clean, soft hands, regardless of your work with this wonderful waterless soap. There's nothing else like ZEV—AS HARMLESS AND AS PLEASANT AS COLD CREAM. No grit or pumice. No alkali! Absolutely pure and neutral. *Simply apply, rub, and remove with waste or towel.*

Keep a can at the shop, in your car, in your home. Hundreds of satisfied users among machinists, miners, engineers, firemen, business and professional men. A trial convinces where words fail. Send 25 cents for large sized can today. *Absolutely guaranteed to please or money refunded.*

Ask about our agent plan.

ZEV
Waterless SOAP

PARKE CORPORATION, Dept. L, Kalamazoo, Mich.
Enclosed find 25c for a full sized trial can of ZEV.
☐ I am (am not) interested in your agent plan;
☐ Send me more information about ZEV.

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ONLY small capital is needed to start. The business is clean, pleasant, profitable. Many successful men of today started their careers in the bicycle business.

You become your own boss, develop a well-paying business, and build for an independent future.

Bicycles are big sellers today everywhere. The profit is generous. Get started now—be prosperous. Write for particulars to Dept. 251.

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Easiest of all instruments to play and one of the most beautiful. Three first lessons sent free give you a quick easy start. In a few weeks you can be playing popular tunes. You can take your place in a band or orchestra in 90 days, if you so desire. Most popular instrument for dance orchestras, home entertainments, church, lodge and school. A Saxophone player is always popular socially and has many opportunities to earn money.

Six Days' Trial and easy payments arranged. 173

Free Saxophone Book

Shows all Buescher models and gives first lesson chart; also pictures of famous professionals and orchestras. Just send your name for a copy. Mention any other instrument in which you may be interested.

BUESCHER BAND INSTRUMENT CO.
Everything in Band and Orchestra Instruments
705 Buescher Block, Elkhart, Indiana

Hunting Whales with Gun-Driven Harpoons

(*Continued from page 41*)

In less than 20 minutes we had sighted, killed, and disposed of a whale worth between $3000 and $4000—the work of a day or more for a whaler's crew in the old days of the longboat and hand harpoon; dangerous work then, too, which might have cost the lives of several men and the destruction of a couple of boats!

The second whale was a mile or so away from us, so the *Traveler* put on full speed, slowing down to quarter speed when about 300 yards away. This animal, too, was floating lazily on the surface, but swung its huge tail in the air, thrashed its flukes once, and submerged.

NOW, a whale requires oxygen. It can remain submerged only for five minutes or so. Then it must come to the surface to breathe. And so the skipper swung the *Traveler* in a great circle—three miles or so in diameter. For almost an hour we cruised at half speed without sighting the big mammal. Then Cappelin reported a "pod" of four whales spouting and playing two or three miles out to sea. Our circling immediately ceased. Four unsuspecting whales in plain sight offered more favorable chances of a kill than did one whale that had dived to escape us.

These whales saw us as we approached. They did not dive, but moved closer together and started slowly out to sea. Swanson called for full speed ahead. He did not steer straight for the whales, but held a course that would permit him to come about into range of the largest whale—if the whales kept to their original course. In half an hour we were abreast of them. We passed them, and the whales, paying no attention to us, began playing again. Swanson put about. Slowly we crept up to within 100 yards of the largest animal, and—boom!—our gunner tried a flying shot over the port side of the bow.

STRAIGHT the harpoon flew to its mark. And almost at the instant it struck, the whale disappeared below the surface.

The cable drum below us roared and screeched as the great hawser spun out under the pull of that massive, sinking body. On and on the cable sped, taut as a circus rope, hissing and creaking as it passed across the deck and through the hawser hole. A thousand feet or more went off; then the movement ceased, the rope went slack, and the sound of the turning winch came from below.

Soon the whale appeared above the surface. It was not dead, for with a thrash of the flukes that would have reduced a small boat to splinters, the animal tried to dive again. But even as it stood on its head in the water, death came, and the tail descended with a crash that sent the other whales to sounding—and our second prize of the day rolled idly on the waves.

Now, two whales in a day are a very fair catch. One modern whaler is known to have taken five in a day, but apparently Captain Swanson was satisfied with his kill of two, and soon we were moving shoreward, our two inflated "humpbacks" trailing behind us on towlines like a pair of scows. Our destination was the oldest land station of the whaling industry of the west coast, established in 1851, and now, under modern methods, the largest shore whaling station in the world.

THERE the big carcasses are hauled up to shore on runways, to be prepared for market. The whalers of old saved nothing of the whale but the oil, the whalebone, and the rarely found ambergris. The modern whaler, though, finds a use for every part of the whale.

From the blubber he gets whale oil, worth only 40 cents a gallon in the old days of whaling, but now bringing $1.40. Sperm oil comes from the cell cavities of certain varieties of whales. Whalebone—the curtain of fibrous growth through which these marine monsters strain their food—is taken from others. The bones are ground to make poultry feed. The flesh and viscera are used for fertilizer. The hide of some types is converted into heavy leather or ground for fertilizer. The fins and tails are used in the manufacture of bristles for brushes, or dried and shipped to Japan and China, where they are used as food. Once in a while the carcass of a whale yields a lump of ambergris, worth from $30 to $35 an ounce to manufacturers of perfume.

That, then, is modern whaling. The methods of cutting up the whale, trying out the oil, and preserving the whalebone are still those that were used 75 years ago. But all else has changed.

Melting Steel by Wireless

STEEL MELTING furnaces already have been made in England wherein the steel is melted by wireless waves, according to Prof. C. H. Desch of Sheffield University. These furnaces are a development of electrical high-frequency induction furnaces in which a 200-volt current was used, Professor Desch explains, the heat being generated in the metal, so that the metal really melts itself.

List Causes of Accident

A DOZEN causes of highway accidents have been listed by engineers of the U. S. Bureau of Public Roads, as follows:

Blind curves, blind road intersections, sharp curves on embankments, unprotected embankments, narrow bridges, sharp convex vertical curves, slippery road surfaces, steep grades, narrow road crowns, sharp curves at bridge approaches, grade crossings, and unbanked curves.

Many Are Color Blind

COLOR blindness is more prevalent among men than women, recent experiments indicate. Approximately five per cent of all men are unable to distinguish one or more colors, while only about one per cent of women are so affected. Near-sight has a bigger field of color discrimination than far-sight.

Wool from Pine Trees

AN ARTIFICIAL wool made from pine trees recently has been developed in Germany. By means of a chemical process a fine filamentary substance is obtained from the long slender spines of the *Pinus sylvestris*, otherwise known as the Scotch fir. In quality this wood-wool is said to be very similar to ordinary wool, and may be curled, felted, or spun in the same way.

Age of the Earth's Crust

THE earth's crust is 1,600,000,000 years old, according to Prof. Alfred C. Lane of Tufts College. He bases his estimate on experiments he has conducted in the disintegration of radium into lead. It takes 1700 years, he says, for a given quantity of radium to become half lead.

The Garlic Taste in Milk

AMERICAN dairy interests recently appealed to the Department of Agriculture for a solution of the problem of preventing the garlicky taste in milk from cows that have eaten garlic. Experts of the department determined that the only way is to keep the cows from the weed, in which they revel.

"Boys Are Born Gentlemen"

SO SAYS Miss Bess V. Cunningham, executive secretary of the Institute of Child Research, Teachers College, Columbia University. Her statement is backed by the fact that, in experiments on boy and girl babies, when 53 pairs of babies of opposite sex were put in an inclosure together, the boys invariably gave up their toys to the girls.

Woman Scientist Honored

FOR the first time in America science officially crowned a woman, when Miss Florence Rena Sabin was elected recently to life membership in the National Academy of Sciences.

Miss Sabin, physiologist at Johns Hopkins Medical School at Baltimore, Md., received the high honor on account of notable research work with blood cells. The number of women attaining prominence in science and invention has increased tremendously within the last 10 years, as is indicated in the illuminating story of women inventors on page 44 of this issue.

SEVERAL Indians on the Quinaielt Reservation in the State of Washington, each earn over $4000 a year fishing for salmon.

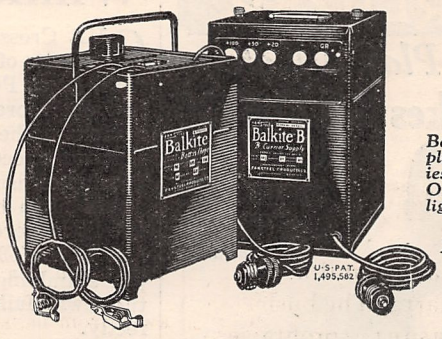
THE average horse is worth $64 and eats over $80 worth of food a year, farm economists estimate.

New Daylight Movies

MOVING pictures shown in broad daylight! Reports reaching this country from Hungary say that a young bookbinder in Budapest has discovered an ingenious way to make that possible.

Instead of projecting pictures against a white screen in the usual method, they are thrown against a rapidly rotating disk covered with strips of dark green and dark blue paper that radiate from the center.

Balkite Battery Charger. Charges 6 volt "A" storage batteries.
Price $19.50
West of Rockies $20
In Canada $27.50



Balkite "B"—replaces "B" batteries and dry cells. Operates from light socket.
Price $55
In Canada $75

An unfailing power supply for both circuits

Here at last is an unfailing power supply for your radio set. Balkite Radio Power Units furnish constant uniform voltage to both "A" and "B" circuits and give your set greater clarity, power and distance. The Balkite Battery Charger keeps your "A" storage battery charged. Balkite "B" replaces "B" batteries entirely and furnishes plate current from the light socket. Both are based on the same principle, are entirely noiseless, and are guaranteed to give satisfaction. *Sold by leading radio dealers everywhere.*

FANSTEEL
Balkite *Radio Power Units*

BALKITE BATTERY CHARGER — BALKITE "B" PLATE CURRENT SUPPLY

Manufactured by FANSTEEL PRODUCTS CO., *Inc., North Chicago, Illinois*

SEND FOR THE INTERNATIONAL CATALOG

Our net price list. Full line of auto bodies and accessories for Fords at *Wholesale Prices*. Save big money on bodies by buying Direct from Factory.

FOR FORD—Prices from $27.85 up. Factory to consumer direct—Pay only One Profit

International Body Works, 914 W. Ohio St., Dept. 8, Chicago, Ill.

I Need Branch Managers

CHARGES INSTANTLY

LIGHTNING—
Wonderful New Electrolyte

charges discharged batteries instantly. Eliminates old sulphuric acid method entirely. Dissolves sulphation. World has waited half a century for this invention. One gallon, retails $10.00, free to agents.

LIGHTNING BATTERY CO., ST. PAUL, MINN.

New-Better-Simple Lawnmower

direct from factory

Trims Close to Walls, Trees, Shrubs

MONTAMOWER

Neater lawn, less work, saves hand trimming. Cuts tall as well as short grass, dandelions, weeds. Only 7½ lbs. Quiet running. Great for terraces. Thousands of satisfied users. Strong guaranteed mechanically perfect. Costs less than ordinary heavy lawnmower. Send coupon.

Reduced price offer

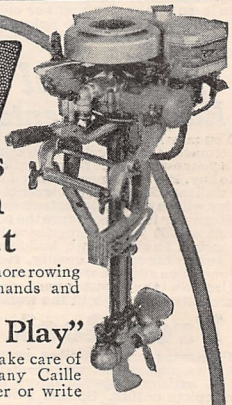
MONTAGUE MFG. CO.
148-154 Louis St., Grand Rapids, Mich.

Without obligation send pictures and description of MontaMower and reduced price offer.

NAME_____

ADDRESS_____

$37



Puts This Motor on Your Boat

Only $37.00—then no more rowing—no more blistered hands and aching muscles. Our

"Pay as You Play"

plan makes it easy to take care of the balance. Covers any Caille motor. Ask your dealer or write us for details.

CAILLE DETROIT **5 Speed Twin**

Speed changes made mechanically and positively by raising or lowering steering handle in ratchet. Provides high speed forward, trolling speed, fast reverse, slow reverse and neutral. When set at neutral, motor runs while boat stands still. Exclusive Caille feature.

Other Features

Twin cylinders—no vibration. Light weight. Zenith carburetor. Eismann magneto. Motor tilts over obstructions. Rope starter. Beautiful finish. Fully guaranteed. Send for details—now.

THE CAILLE PERFECTION MOTOR CO.
6340 2nd Boulevard Detroit, Mich.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 17.

WURLITZER
REG. U.S. PAT. OFF.

Couldn't Play a Note—
Now Makes $100.00 a week

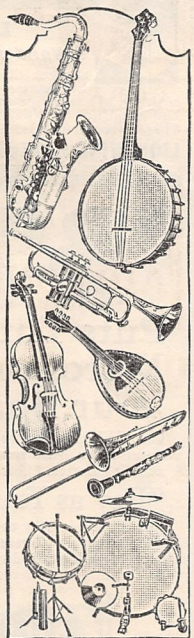
"Bill Carola" Landaus Serenaders

Read Bill Carola's story in his own words—
"When I sent for your catalog, I wanted a Tenor Banjo, but I hesitated a long time as I didn't know a note of music. I finally decided to try it a week, as you offered, and at the end of that time I found I could pick a few notes. Then I started the correspondence course you furnished, and in seven months, even before the final payments on the Banjo were due, I had taken my place in a professional orchestra. Now I am making $100 a week, three times what I made as a clerk. Two of my friends made money with their instruments after five months practice, one a drummer and the other a saxophonist, and neither could play a note when he started. I wish everybody knew how easy it is—anyone who can whistle a tune can learn to play a musical instrument."
Bill Carola

New Offer

Learning to Play Made Easy

FREE We now furnish with every instrument a **Free Scholarship Certificate.** This scholarship entitles you to free tuition in one of the foremost correspondence schools of music in the country. Whether you want to learn to play for profit or only for pleasure, this **Free Scholarship** will make it surprisingly easy for you.



Free Trial Easy Payments

You may have any Wurlitzer instrument for a week's free trial in your own home. No obligation to buy. Payments are arranged in small monthly sums, a few cents a day will pay for your instrument. Wurlitzer instruments are the result of 200 year's experience in musical instrument building. Famous for artistic quality, rich tone value and fine workmanship. Used in the finest bands and orchestras throughout the world.

Free Book

Illustrates and describes every known musical instrument—over 3000 articles. Special offers on complete outfits. Special prices direct to you. We also give you our Free Trial, Easy Payment plan and special **Free Scholarship** Offer. No obligation.

Send Coupon Today

The Rudolph Wurlitzer Co., Dept. B-178
117 E. 4th St., Cincinnati — 329 So. Wabash Ave., Chicago
120 W. 42nd St. New York — 250 Stockton St., San Francisco

Send me your Free Book on Musical Instruments. Also your Free Trial, Easy Payment plan and Free Scholarship offer. No obligation.

*Name*_____

*Address*_____

*City*_____ *State*_____

*Instrument*_____
(State instrument in which you are interested)

Winners in Cross-Word Puzzle Contest

OUR Cross-Word Puzzle Contest, the results of which are announced herewith, gives POPULAR SCIENCE MONTHLY just one more reason to be proud of its readers. The number of correct solutions that were received to this really difficult puzzle was astonishing. And the number would have been much greater but for two little words—LOADS (95 horizontal) and I. S. (53 horizontal). These were the stumbling-block for the majority of those who failed to solve the puzzle correctly.

LOADS (the plural of the output of an electric power station) is a technical term, though one frequently used, and it is understandable that the non-technical puzzle solver might have difficulty in catching the right combination. But with I. S. (the symbol of the Popular Science Institute of Standards) appearing several times on virtually every page of our advertising section, the reason for this portion of the puzzle proving an insurmountable barrier to any one is not so apparent.

The uniform excellence of the letters that accompanied the vast number of correct solutions received made the selection of the winners as difficult, possibly, for the judges as was solving the puzzle for the contestants. The selections made by the judges are as follows:

L	A	T	H	E	■	P	R	I	S	M	■	F	A	C	E	T
U	■	B	O	L	T	■	E	R	G	■	C	O	N	E	■	R
N	A	■	D	I	E	D	■	O	■	B	O	N	E	■	P	I
A	R	C	■	S	C	I	E	N	T	I	S	T	■	B	E	E
R	E	A	M	■	H	A	M	■	A	N	T	■	G	R	A	D
■	A	N	I	L	■	L	E	A	P	S	■	S	E	A	L	■
E	■	A	C	E	A	■	R	U	E	■	S	A	N	D	■	A
C	E	■	R	E	L	A	Y	■	R	A	N	G	E	■	R	F
H	A	L	O	■	I	S	■	■	■	Z	A	■	R	O	O	T
I	R	■	B	E	V	E	L	■	A	O	R	T	A	■	T	E
N	■	S	I	N	E	■	E	L	M	■	L	I	T	H	■	R
■	F	L	A	T	■	C	U	S	P	S	■	C	O	A	L	■
P	L	A	N	■	S	A	C	■	L	I	D	■	R	E	I	N
L	U	G	■	B	A	R	O	M	E	T	E	R	■	M	O	A
A	X	■	C	A	M	S	■	E	■	E	C	H	O	■	N	D
N	■	R	A	S	P	■	C	G	S	■	A	U	T	O	■	I
T	I	T	L	E	■	L	O	A	D	S	■	S	O	L	A	R

Solution of cross-word puzzle that appeared in the March POPULAR SCIENCE MONTHLY

FIRST PRIZE, $50
Marad Serriov, Miami, Fla.

SECOND PRIZE, $25
Mrs. W. E. Henderson, Eva, Okla.

TEN PRIZES OF $1 EACH

Ben W. Clawson, Washington, Ind.; Bill Hetherington, Chicago, Ill.; Henry L. Hurxthal, Mansfield, Ohio; James L. Kinter, Jr., Homer City, Pa.; Georgia Leonard, Delaware, Ohio; Mrs. E. H. May, Washington, Pa.; Sister M. Bathildes, Loretto, Colo.; Edith B. Sterns, Charlottetown, P. E. I., Can.; H. W. Swafford, Salem, Oreg.; Earl D. Wilson, Columbus, Ohio.

HONORABLE MENTION

M. M. Alpaugh, Annandale, N. J.; George Annala, National Mine, Mich.; Henry P. Baum, Winona, Minn.; Sergt. Ernest Berkel, Fort George Wright, Wash.; James Bremner, Chicago, Ill.; H. S. Burroughs, Chicago, Ill.; Jean P. Campbell, Halifax, N. S., Can.; Edna M. Carter, Fayette, Ia.; S. E. Cresswell, Tampa, Fla.; Ruth Tolson Dederick, Vancouver, B. C.; Patsy Difloure, Alliance, Ohio; Florenz Droesch, Brooklyn, N. Y.; Fred Heath Foster, Oxford, Ind.; Caroline H. Garland, Dover, N. H.; Diana S. Glickman, Brighton, Mass.; Estella Goldsmith, State College, Pa.; Charles E. Graham, Chapel Hill, N. C.; G. W. Heitkamp, Dubuque, Ia.; B. Eva Hoehn, Carlinville, Ill.; Robert A. Inglis, Woodroffe, Ont., Can.; William H. Inman, Washington, D. C.; J. L. Kane, Carnegie, Pa.; L. J. Mack, Sibley, Ill.; Roy McCann, Algiers, La.; J. F. McFadden, Spokane, Wash.; August Merz, East Orange, N. J.; S. A. Morton, Halifax, N. S., Can.; Mabel E. Norcross, Lewiston, Me.; Guido Pantaleoni, Jr., New York City; Mrs. Guido Pantaleoni, Jr., New York City; K. S. Rabb, Waterloo, Ont., Can.; Georgia Reams, Kellerton, Ia.; A. M. Reeves, Havre de Grace, Md.; Samuel A. Sloan, Pittsburgh, Pa.; Arthur L. Smith, Mildred, Pa.; R. G. Somers, Moorcroft, Wyo.; Mrs. K. Ray Spencer, Omaha, Neb.; G. A. Stephens, Jacksonville, Fla.; Jos. Stock, St. Louis, Mo.; Geo. W. Sykes, Newport, Ark.; Charles E. Teeters, Indianapolis, Ind.; Alma Tweed, Lake Mills, Ia.

What Interests You Most in This Magazine?

EVERY mail is full of letters from our readers, telling us what they like about POPULAR SCIENCE MONTHLY—why it interests them and how they make use of ideas contained in its pages. A few typical letters appear below. They simply indicate the very real influence this magazine has with its readers, and the pleasure it affords them.

Why do *you* read POPULAR SCIENCE MONTHLY? Write to us and tell us about it.

Here's what others say:

Of High Literary Standard

I wish to take this opportunity of giving you credit for your magazine, the contents and appearance of which are unexcelled for a magazine of its kind, its leading articles especially being very instructive, educative, and of a high literary standard. —R. G. T., Winnipeg, Canada.

Couldn't Get Along Without It

I think POPULAR SCIENCE MONTHLY is the best magazine of its kind published and feel that I could not get along without it.—C. M. R., Louisville, Ky.

More Than Worth the Money

POPULAR SCIENCE MONTHLY has been a very fine and helpful magazine and is more than worth the money. It is economical and satisfactory.—J. O. G., Bradentown, Fla.

A Wonderful Book of Information

I may say that I find POPULAR SCIENCE MONTHLY a wonderful book of information.—P. C. D., Grand Falls, Newfoundland.

Likes Automobile Articles

I get a lot of good from POPULAR SCIENCE MONTHLY, especially the articles on automobiles.—F. F., Sacred Heart, Minn.

Seaplane Sets Speed Record

A WORLD'S record for large seaplanes was made recently when the PN-9 skimmed over the Delaware River course at 128 miles an hour. It was the first flight of the seaplane. The PN-9 is made of duralumin and when fully equipped and manned weighs 1800 pounds and carries five in crew. It is said to have a flying range of 2200 nautical miles.

Vitamine X, the Giant-Maker

A FACULTY member of the University of California, Dr. Herbert M. Evans, recently announced a development of glandular nutrition that, he claims, materially increases the size of animals inoculated with it.

Doctor Evans says that this vitamine is found distributed in ordinary foods, but for inoculation it is taken from the pituitary gland of the animal that is to be inoculated. The gland yields a certain fluid, and this fluid is Vitamine X. Animals treated with injections of the fluid—as guinea pigs, rats, and tadpoles—have grown so much larger than normal that Doctor Evans declares a daily injection for a period of time instead of at infrequent intervals would produce a race of giants of their kind.

Efforts are being made by Doctor Evans and his assistants to purify the vitamine X fluid so that it even might be given to humans as a restorative.

Conserving Airplane Power

PAUL PAINLEVE, Prime Minister of France, recently was the sponsor of a new appliance, the invention of Louis d'Amblanc, that is said to enable airplane engines to maintain their power at great heights. Airplanes lose half their power when they rise above 18,000 feet. With the d'Amblanc appliance, it is claimed, an airplane loses very little power. Weighing only 16 pounds, the appliance is fitted to the interior of the engine. Trials made by the French Air Service are said to have proved the appliance's value.

Birds Once Had Teeth

THE old saying, "Scarcer than hen's teeth," could not have held good in prehistoric ages. The earliest fossils of birds that have been found have large numbers of sharp teeth.

Chestnut Trees from China

THE U. S. Department of Agriculture hopes to restore the chestnut forests of the Eastern States, destroyed by blight, by encouraging the cultivation of a new blightproof chestnut from China.

The Warmest Blankets

RECENT tests by the U. S. Bureau of Standards show that blankets of moderate density keep the indoor sleeper warmer than those that are closely woven or dense; also that cotton blankets can be used over sheets to good advantage by all except those who, like campers, sleep where it is damp.

Cotton blankets were found to resist the passage of heat as effectively as wool.

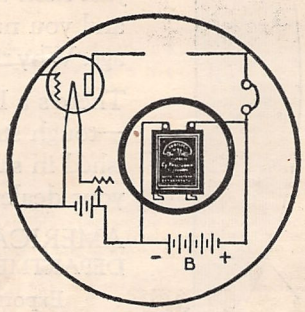
By-Pass Condensers remove disturbing noises and reduce losses

By-Pass Condensers do a double job. They filter the fluctuating "B" battery current. They provide a free path for the radio frequency currents around the high internal resistance "B" battery.

The first function tends to remove disturbing noises—the second increases efficiency by reducing losses and properly routing the available energy.

The tone quality of every set will be greater in strength—purer—smoother—with a By-Pass Condenser.

External connections for the By-Pass Condenser may be made by connecting it from the minus "B" terminal to the plus "B."



Dubilier

CONDENSER AND RADIO CORPORATION

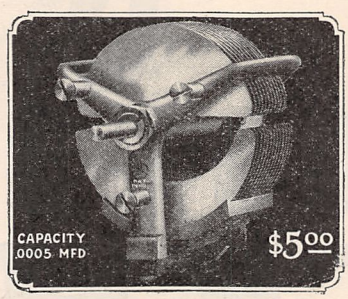
$71.25 PROFIT IN 45 MINUTES

Made by Le Roy Blades Without Experience

New mechanical wonder showed 38½% saving on gas in 14,000 mile test. Gives more power, speed, pep. Removes carbon. Easily attached. One free to introduce. Exclusive territory.

Air-Vac Co., 6357 Broadway, Chicago

INSIST UPON AMSCO AIR CONDENSERS VERNIER & VARIABLE



Cutlass Plates Give Precise Tuning

This Ultra-Lowloss Condenser is built to overcome losses usually experienced in other condensers.

The Cutlas Stator Plates are specially constructed to simplify tuning—spread the stations evenly over a 100 degree scale dial, each degree representing approximately 3½ meters.

Designed by R. E. Lacault, originator of the famous Ultradyne Receivers.

ULTRA-LOWLOSS CONDENSER

PHENIX RADIO CORPORATION
114-A E. 25th Street, New York City

DAY AND NIGHT SELLER

Test it COST-FREE

Stick-a-lite, new kind of portable auto trouble lamp, sells on sight, because powerful magnetic base sticks to any iron or steel part of car at any angle—even upside down—leaving both hands free to work. Reaches any part of car. Also powerful spotlight and camplight. Indispensable to every motorist. Spectacular demonstration on any car in one minute. Every car a prospect. 8 out of 10 men buy. Sells for only $2.50. Your profit $1.25.

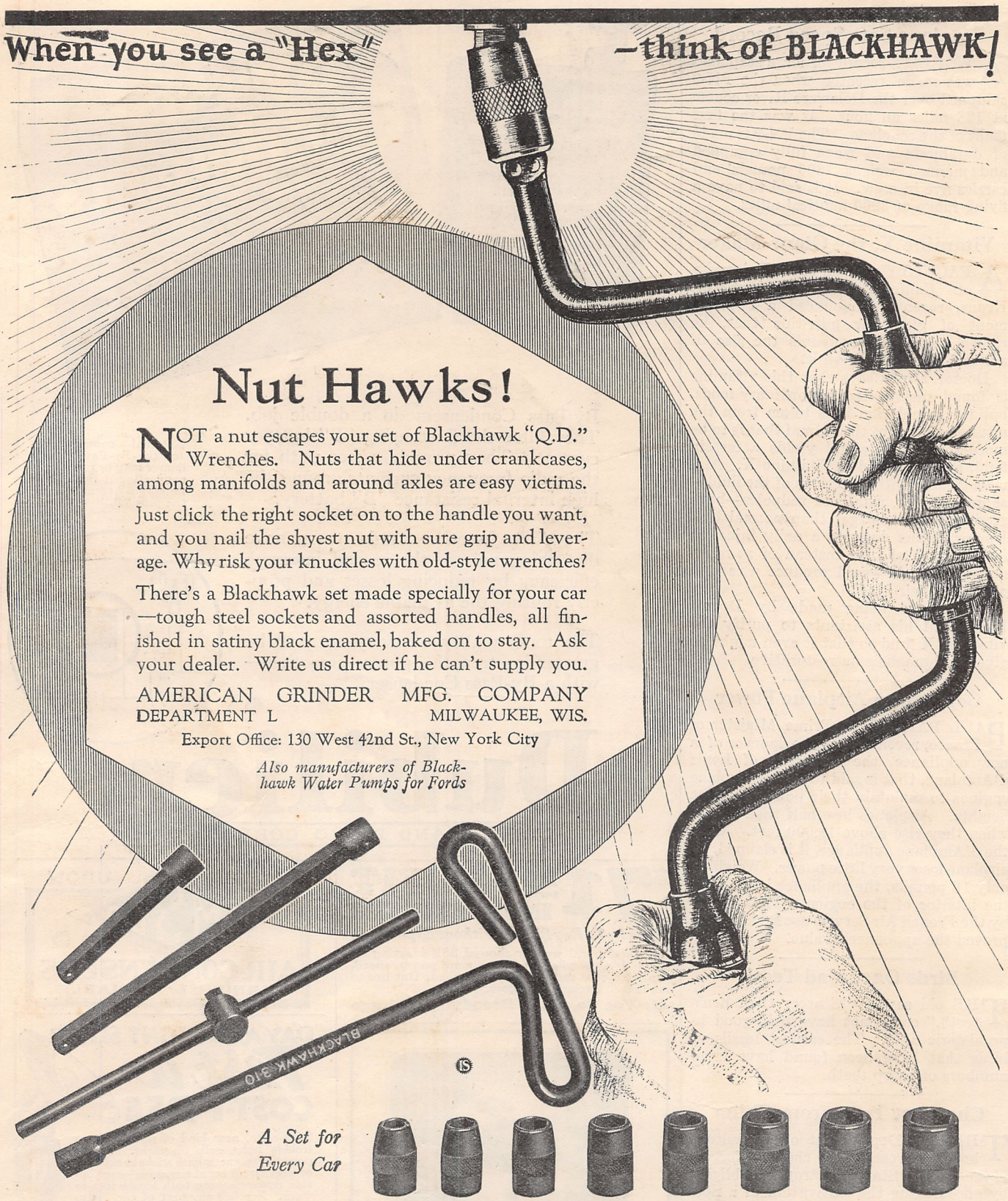
$1 A MINUTE

Wilson actually made that for one hour. Toffer, Merrill, Clark, Machemer, and Dawes, each have standing order for 800 a month. Schoolboy sold 35 in one afternoon. Send $2.00 deposit for demonstrator. Test it one evening. Deposit refunded if demonstrator is returned within 30 days. If you wish, send no money—only postcard for details. Act quick for big summer season. Join the men who are making $200 a week.

PREMIER ELECTRIC COMPANY
Dept. 4-H 1800 Grace Street, Chicago, Ill.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 17.

When you see a "Hex" —think of BLACKHAWK!



Nut Hawks!

NOT a nut escapes your set of Blackhawk "Q.D." Wrenches. Nuts that hide under crankcases, among manifolds and around axles are easy victims.

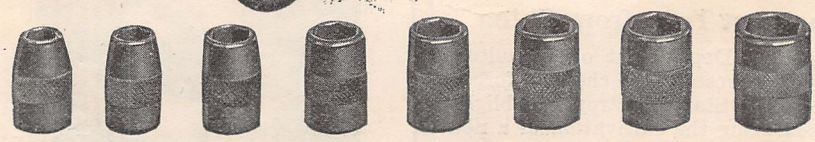
Just click the right socket on to the handle you want, and you nail the shyest nut with sure grip and leverage. Why risk your knuckles with old-style wrenches?

There's a Blackhawk set made specially for your car —tough steel sockets and assorted handles, all finished in satiny black enamel, baked on to stay. Ask your dealer. Write us direct if he can't supply you.

AMERICAN GRINDER MFG. COMPANY
DEPARTMENT L MILWAUKEE, WIS.
Export Office: 130 West 42nd St., New York City

Also manufacturers of Blackhawk Water Pumps for Fords

A Set for Every Car



BLACKHAWK

Welded Wrenches

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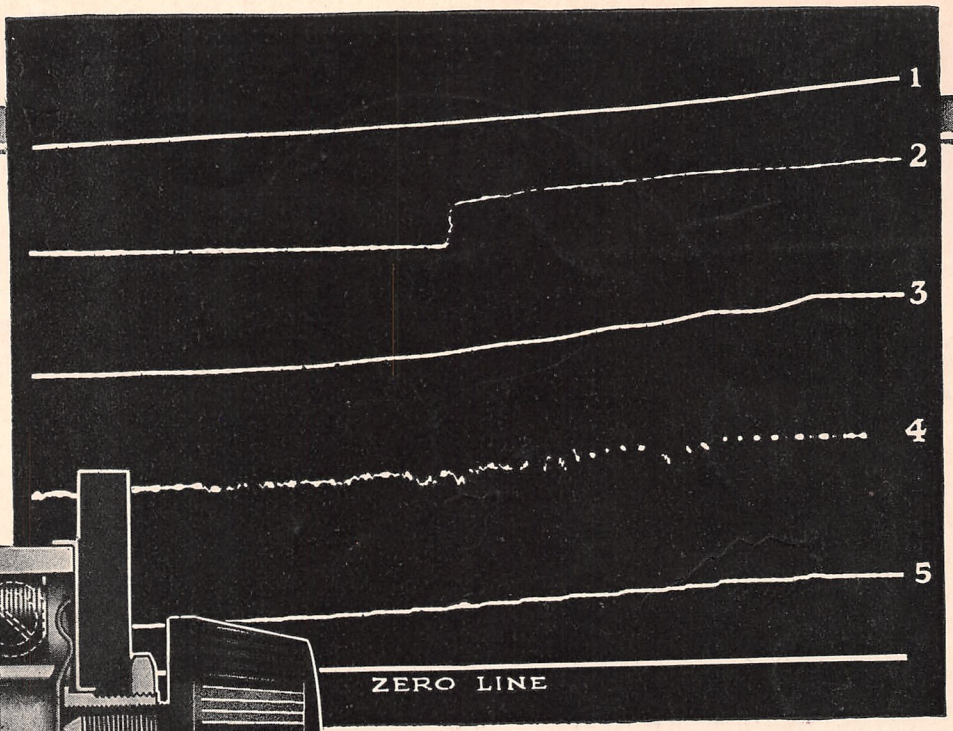
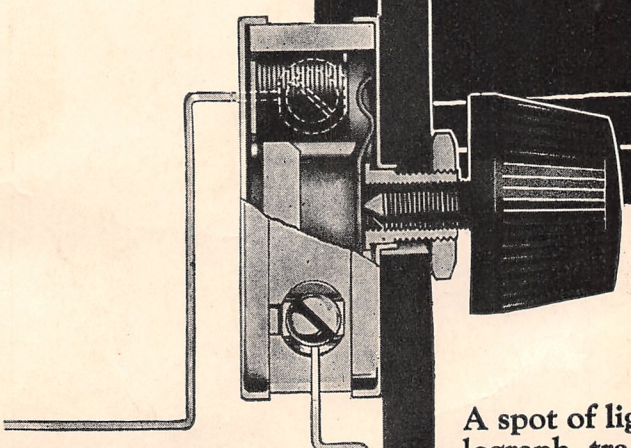
Printed by Art Color Printing Co., Dunellen, N. J.

Bradleystat

PERFECT FILAMENT CONTROL
The result of more than twenty years' research and experience in the manufacture of graphite disc rheostats for radio, mines, mills, etc.





Only Graphite Discs

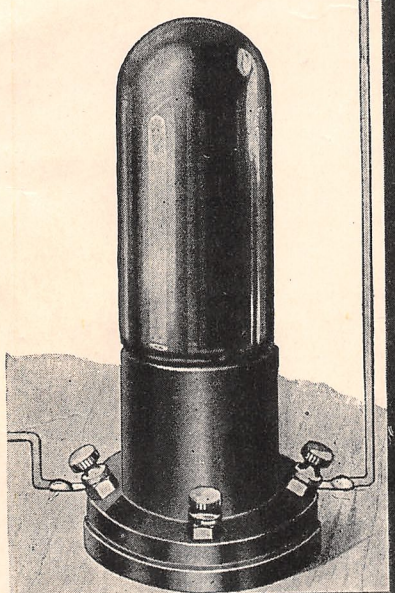
provide noiseless filament control

A spot of light, silently guided by an automatic electric oscillograph, traced the above curves on a moving photographic film. The test, made at the University of Wisconsin, was impersonal and impartial. The result, however, proves beyond a doubt the superiority of the Bradleystat for radio filament control.

The first line (No. 1) shows the silent, stepless variation produced by the Bradleystat. The following curves (Nos. 2, 3, 4, and 5) were produced by other types of rheostats, some using loose powder instead of graphite discs. See the scratchy, noisy control. Every jog in the white lines means a distracting noise in the loud-speaker.

Is it any wonder that Bradleystats are being substituted for ordinary rheostats by thousands of set owners? Try one, yourself, and hear the difference!

Use the same Bradleystat for ALL Radio Tubes without changing connections.



Allen-Bradley Co.
Electric Controlling Apparatus

293 Greenfield Ave. A-B Milwaukee, Wis.

Mfrs. of graphite disc rheostats for over twenty years.

Mail the Coupon for Literature

Allen-Bradley Co.
293 Greenfield Ave., Milwaukee, Wis.

Please send me your latest literature on the Allen-Bradley line of radio devices.

Name.....

Address.....

All outdoors invites your Kodak

Autographic Kodaks *$6.50 up*

Eastman Kodak Company, Rochester, N.Y., *The Kodak City*